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ESTIMATING THE COST OF EQUITY CAPITAL FOR PROPERTY-LIABILITY INSURERS

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Estimating the Cost of Equity Capital for Property-Liability Insurers

Abstract

This paper presents new evidence on estimates of the cost of equity capital by line of insurance for the property-liability insurance industry. To do so we obtain firm beta estimates and then use the recently developed full-information industry beta methodology to decompose the cost of capital by line. We obtain beta estimates using both the standard one-factor CAPM model as well as the Fama-French three-factor cost of capital model. The analysis suggests the cost of capital for insurers using the Fama-French model are significantly higher than estimates based upon the CAPM. In addition, we find evidence of significant differences in the cost of equity capital across lines, indicating that the use of a single company-wide cost of capital is generally not appropriate.

1. Introduction

Cost of capital estimation is becoming increasingly important for property-liability insurers. First introduced during the 1970s in regulatory proceedings in New Jersey, Massachusetts, and other states, the application of financial methods in pricing, reserving, and other types of financial decision making has grown rapidly over the past two decades.[1] Recent developments include the emergence of asset-liability management (ALM) techniques (Panjer 1998), the development of methodologies to allocate equity capital by line of business (e.g., Myers and Read 2001), the increased focus on market-based project evaluation techniques such as risk-adjusted return on capital (RAROC), and the projected introduction of fair value accounting for insurer liabilities (Girard 2002). These and other changes have intensified the need to find reliable methods to estimate the cost of capital for insurance firms.

In terms of financial theory, insurers are no different from other corporations in the economy with respect to the general factors that determine the cost of capital and the market value of the firm. However, it is well-recognized that the cost of capital varies across industries due to the heterogeneity of the risks facing firms in various sectors of the economy; and cost of capital research has shown that there is a significant industry factor for insurance (Fama and French 1997). Insurance is a very diverse industry, however,

[1]Most of the important early financial pricing papers are collected in Cummins and Harrington (1987). More recent developments are reviewed in Cummins and Phillips (2001). Insurance pricing models that rely on estimates of the cost of capital are presented in Cummins (1990) and Taylor (1994).

encompassing numerous lines of business with different risk characteristics. It is unlikely, for example, that the cost of capital for a firm specializing in life insurance will be the same as the cost of capital for a firm emphasizing workers' compensation or commercial liability insurance. Unfortunately, little progress has been made in estimating costs of capital for insurers with different business line compositions. The objective of the present paper is to remedy this deficiency in the existing literature by developing cost of capital models that reflect the line of business characteristics of firms in the property-liability insurance industry. We focus on property-liability insurers because costs of capital tend to differ across industry segments (see below) and because of the long-term interest in cost of capital for property-liability insurers due to price regulation, which is not present for other types of insurance.

The problem addressed in this paper, i.e., the estimation of the cost of equity capital for insurers with different business line compositions, has been studied in the financial literature as the problem of estimating the cost of capital for divisions of conglomerate firms. The problem in estimating the divisional cost of capital is that the conglomerate firm itself rather than the division is traded in the capital market. Thus, it is possible to use market value data to estimate the overall cost of capital for the conglomerate but not for the individual divisions comprising the firm. The classic approach for estimating the divisional cost of capital is the *pure play approach* (Fuller and Kerr 1981). The pure play technique involves identifying publicly traded firms that specialize in the same product as the division under consideration (i.e., that have a "pure play" in that product) and then approximating the divisional cost of capital as the average cost of capital for the pure play firms.

Although the pure play technique performs well in some instances, particularly when a relatively large number of pure play firms of various sizes can be found, there are also situations where it does not provide a satisfactory solution to the divisional cost of capital problem. In particular, there may be only a few true specialist firms in some product lines and they may be small, accounting for only a small proportion of industry output (Ibbotson Associates 2001). Because small firms tend to have higher costs of capital than large firms, using pure play cost of capital estimates from relatively small firms to determine the cost of capital of a (potentially much larger) division of a conglomerate firm can lead to biased estimates of the divisional cost of capital. Unfortunately, the property-liability insurance industry is an example of the type of industry where the pure play approach is unlikely to work very well. The vast majority of insurance premiums are written by firms that write several lines of business rather than specializing in one or two closely-related lines of business. In addition, relatively few insurers are publicly traded, with the majority of firms in the industry owned by financial or non-financial conglomerates or having the mutual ownership form.

In this paper, we adopt a relatively new methodology, the *full-information industry beta (FIB) approach*, that overcomes the principal limitations of the pure-play methodology. The full-information beta methodology was first proposed by Ehrhardt and Bhagwar (1991) and significantly modified by Kaplan and Peterson (1998). Instead of discarding the overall cost of capital estimates for conglomerates, as is done in pure play analysis, the full-information beta approach utilizes a sample of conglomerate and specialist firms to identify the impact of various lines of business on the cost of capital. The underlying insight is that the *observable* beta for the conglomerate is a weighted average of the *unobservable* betas of the underlying lines of business. The method proceeds by performing a cross-sectional regression for a sample of firms, where the dependent variable is the observable beta and the independent variables measure the firms' participation in various industries and lines of business. The coefficients of the line of business participation variables are then interpreted as the full-information beta coefficients for the business lines. The resulting regression equation can be used by firms outside of the estimation sample to estimate the cost of capital taking into account their own line of business compositions. Hence, the results could be used to produce cost of capital estimates for non-traded stock firms and mutuals. The method also can be used to estimate the cost of capital for insurers specializing in particular industry segments or for subsidiaries of insurers and conglomerates specializing in various lines of business.

The approach taken in this paper is to illustrate the full-information beta approach to cost of capital estimation using a sample consisting of all firms (insurance and non-insurance) listed in the Compustat data base that meet our sample selection criteria for the sample period 1997-2000. Our first set of FIB regressions, based on the Compustat data, produces beta estimates for all two-digit industries defined by the North American Industry Classification System (NAICS), including the property-liability insurance industry. Our second set of FIB regressions supplements the Compustat data with data from the National Association of Insurance Commissioners (NAIC) in order to estimate the cost of capital by line of property-liability insurance. To illustrate the application of the FIB technique in estimating line of business betas, we estimate models that provide cost of capital estimates for heavily regulated lines of business (automobile versus workers compensation insurance), short-tail versus long-tail lines of business, and personal versus commercial lines. For comparison with the FIB estimates, we also estimate the cost of capital for property-liability insurers using the pure play approach.

The betas used as the dependent variables in our full-information beta regressions come from two asset-pricing models – the capital asset pricing model (CAPM) and the three-factor model developed by Fama and French (1992, 1993, 1997). The CAPM and Fama-French methods were chosen for analysis because they are used frequently in determining the cost of capital for corporate capital budgeting and regulatory purposes. The CAPM is important because it was the first equilibrium asset pricing model developed by financial theorists and still plays a prominent role in a many practical applications (Graham and Harvey 2001). The Fama-French three-factor model (hereinafter the FF3F model) was developed in response to the criticism that the CAPM tends to give inaccurate estimates of the cost of capital because it omits important financial risk-factors. The FF3F model retains the CAPM's single factor for systematic market risk and adds factors to capture the effects of firm size (defined in terms of total market capitalization) and the ratio of the book value of equity (BV) to the market value of equity (MV). The former factor controls for the "small firm effect," i.e., the observation that the cost of capital is inversely related to firm size. The BV to MV ratio reflects financial distress, with financially vulnerable firms having higher values of this ratio than stronger firms. This factor controls for the tendency of investors to require higher expected returns on stocks in financially vulnerable firms since these firms will perform particularly poorly exactly when individual investors' portfolios are experiencing overall losses.[2] In implementing the CAPM, there is one FIB regression, with the CAPM beta coefficient as the dependent variable. In the Fama-French methodology, there are three FIB regressions, one each for the three risk-factor coefficients in the Fama-French model.

There have been several prior papers on cost of capital estimation for property-liability insurers. Cummins and Harrington (1985) utilize quarterly profit data to estimate the cost of capital for a sample of fourteen property-liability insurers covering the late 1970s and early 1980s. Their beta estimates were somewhat unstable and conformed to the CAPM in the 1980s but not in the 1970s. Cox and Griepentrog (1988) implemented the Fuller-Kerr (1981) pure play technique for a sample of 26 to 31 insurers (depending on the year) using data from the mid-1970s. Like Cummins and Harrington's, their estimates of the cost of capital tend to be somewhat unstable. Cummins and Lamm-Tennant (1994) develop theoretical and empirical models showing that insurer costs of capital are related to leverage (the ratios of policy reserves-to-assets and the ratio of financial debt-to-assets). Their results suggest that long-tail commercial lines of property-liability insurance tend to have higher costs of capital than short-tail lines. Their sample period ends in 1989. Lee and Cummins (1998) estimate the cost of equity capital for property-liability insurers using the CAPM, the arbitrage pricing theory (APT) model, and a unified CAPM-APT model developed by Wei (1988). They find that the APT and the Wei model perform better than the CAPM in forecasting the cost of capital for insurers. Except for Lee-Cummins, none of the prior research uses data after the 1980s, and none except Cummins and Lamm-Tennant attempts to estimate the cost of capital by line.

The present paper improves on the existing literature by being the first to investigate both the Fama-French three-factor model and the full-information beta technique to study the insurance industry. We also

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[2]The construction of the size and book to market factors are defined in more detail below. Cochrane (1999) reviews the recent empirical asset pricing literature and provides an intuitive discussion of the non-diversifiable risks proxied by the size and financial distress risk factors.

innovate by conducting the first application in any industry of the full-information beta technique to explain the factors of the Fama-French three-factor model. Our research improves on the prior insurance cost of capital literature by using more recent data and focusing on the relationship between the cost of capital and line of business composition. In addition, the sample size in the present study is larger than the samples used in most of the prior research on property-liability insurer costs of capital.

The remainder of the paper is organized as follows: Methods for estimating the cost of capital are discussed in section 2. Section 3 discusses our sample and methodology. The results are presented in section 4, and section 5 concludes.

2. Cost of Capital Methodologies

Several important methodologies have been developed to estimate the cost of capital for corporate financial decision making and regulatory purposes. In this section, we outline these methodologies and explain our rationale for focusing on the approaches considered in the empirical section of the paper. Because the models are well-known, the discussion is brief, and the reader is referred to the literature for further discussion.[3] The details on the implementation of the models are presented in section 3.

The Discounted Cash Flow (DCF) Model

The discounted cash flow (DCF) model has been widely used in regulatory proceedings, both in the insurance and the public utility industries.[4] The model is based on the financial-theoretic proposition that the value of any asset is the present value of its cash flows, where the discount rate is the appropriate cost of capital for the firm or project under consideration. Solving the discounted cash flow formula for the cost of capital yields the following equation:

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[3]An overview of the models is presented in Ibbotson Associates (2001) and the technical details are provided in Campbell, Lo, and MacKinlay (1997).

[4]Brealey and Myers (2002) and Ibbotson Associates (2001) provide details on several variants of the model. Kolbe, Read and Hall (1984) and Thompson (1991) discuss the use of the models in rate regulatory proceedings. Derrig (1990) discusses the development and use of financial pricing models in the context of insurance rate regulation.

$$r_i = \frac{C_{i1}}{V_i} + g_i \qquad \textbf{(1)}$$

where r_i = cost of capital for firm i,

C_{i1} = the firm's expected cash flow next period,

V_i = the market value of the firm in the current period, and

g_i = the expected growth rate of the firm's cash flow in the future.

The cash flow to market value ratio (C_{i1}/V_i) is usually approximated by the firm's projected dividend-to-price ratio or earnings-to-price ratio obtained from financial reporting services such as Thomson Financial or Value-Line. The projected growth rate, also in earnings or dividends, usually is based on a average of financial analysts' forecasts obtained from a source such as the Institutional Brokers Estimation Service (IBES). Because it is often viewed as unrealistic to project a single growth rate in perpetuity, variants of the DCF model have been developed using two or three growth rates rather than the single growth rate shown in equation (1) (Brealey and Myers 2002).

The DCF model provides a practical way to obtain cost of capital estimates that is often useful in checking the robustness of results obtained from single or multiple factor asset pricing models. However, its usefulness is limited in the insurance context because of its reliance on analysts' earnings forecasts to obtain growth rates. Analysts' earnings are typically only available for the largest publicly traded firms. Thus, the sample of companies that could be analyzed using this method is much more limited than the sample used in this study. In addition, the method does not readily lend itself to the decomposition of the cost of capital by line.

The Capital Asset Pricing Model (CAPM)

The capital asset pricing model (CAPM) has been widely used in many financial applications. The CAPM cost of capital is given by the following formula:

$$E(r_i) = r_f + b_{mi}[E(r_m) - r_f] \qquad \textbf{(2)}$$

where $E(r_i)$ = the CAPM cost of capital for firm i,

r_f = the expected return on a default risk-free rate asset,

$E(r_m)$ = the expected return on the market portfolio, and

β_{mi} = firm i's "beta coefficient" for systematic market risk = $Cov(r_i, r_m)/Var(r_m)$

The underlying rationale for the CAPM is that expected rates of return on assets traded in frictionless and informationally efficient capital markets are sufficient to compensate investors for the time value of money at the default-risk-free rate of interest plus a risk premium to compensate investors for bearing systematic market risk. The latter component of the return is equal to the firm's beta coefficient multiplied by the expected market risk premium. In applications of the CAPM, the expected market risk premium is proxied by the long-term average of the difference between the return on a broad market index and the return on a risk-free asset. The most commonly used averaging period is 1926-present, and the broad market index is a market index such as the Standard & Poor's 500 Stock index (S&P 500), the New York Stock Exchange (NYSE) composite index, or a broad market index consisting of NYSE, America Exchange, and Nasdaq stocks.[5] A U.S. government bill or bond rate is used to represent r_f, with the choice of rate usually depending upon the time horizon of the firm or project being evaluated.[6]

Beta coefficients for individual stocks are estimated by a time series regression of a firm's stock returns on the returns on the market portfolio. Most applications utilize monthly data over a five-year period to conduct the regressions. The regressions are usually estimated using ordinary least squares (OLS) with an adjustment to allow for the phenomenon of regression towards the mean, i.e., the tendency of unusually

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[5]Although using the long-term average of the difference between the return on a broad market index and the risk-free rate to represent the expected market risk premium is the most widely accepted approach in the literature, other approaches have been suggested. For a review of the alternatives, see Derrig and Orr (2003). The models estimated in this paper could easily be adapted to incorporate other proxies for the market risk premium.

[6]For example, Ibbotson Associates, a widely-accepted source for cost of capital estimation, recommends the 30-day U.S. Treasury bill yield for short-horizon projects, the 5-year U.S. Treasury coupon note yield for intermediate-horizon projects, and the 20-year U.S. Treasury coupon bond yield for long-horizon projects. Ibbotson Associates (2001), p. 43.

high or low beta estimates to be biased away from their true expected values.[7]

The CAPM is included in our empirical analysis because it remains the most widely used asset pricing model in a wide range of practical applications such as capital budgeting and investment portfolio analysis (see, for example, Graham and Harvey 2001). In addition, more recent methods such as the FF3F method and the full-information beta technique can be viewed as generalizations or extensions of the CAPM. Thus, it is important to include the CAPM as a benchmark methodology in this study.

The Fama-French Three-Factor (FF3F) Model

As mentioned above, the Fama-French three-factor model retains the CAPM risk-premium for systematic market risk but adds risk premia for two additional factors to capture the effects of firm size and financial distress. The factors are defined in detail in section 3 below. The FF3F model has been tested extensively and shown to be a significant improvement over the CAPM (see Fama and French 1992, 1993, 1997, Schink and Bower 1994, Wang 2003).

The FF3F formula for the cost of capital is the following:

$$E(r_i) = r_f + b_{mi}[E(r_m) - r_f] + b_{si} p_s + b_{vi} p_v \qquad \textbf{(3)}$$

where β_{si} = firm i's beta coefficient for the size factor,

π_s = the expected market risk premium for firm size,

β_{vi} = firm i's beta coefficient for the financial distress factor, and

π_v = the expected market risk premium for financial distress.

The risk-premium for systematic market risk, $E(r_m) - r_f$, in the FF3F model is usually the same estimate that is used for the CAPM. This model also uses factors representing *size excess returns* and *financial distress excess returns*, where firm size is defined in terms of total market capitalization (number of shares multiplied by share price) and financial distress is proxied by the ratio of the book value of equity (BV) to the market

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[7]For a discussion of adjusting historical betas for regression towards the mean, see Elton and Gruber (1991).

value of equity (MV). The excess return series are obtained monthly, and long-term averages of the returns are used to compute the risk premia, π_s and π_v. The market, size, and financial distress excess returns are used in a regression analysis to estimate the beta coefficients for systematic market risk, firm size, and financial distress. Finally, the estimated beta coefficients for each firm and the time-averaged risk premia are inserted into equation (3) to estimate the cost of capital for the firms in the sample.[8]

The Full-Information Industry Beta (FIB) Method

As mentioned above, the objective of the full-information beta methodology is to produce cost of capital estimates that reflect the line of business composition of the firm. Such estimates can be used by non-traded stock insurers and mutuals to estimate the cost of capital and can also be used to estimate the cost of capital for divisions of the firm.

The underlying premise of the FIB methodology is that the firm can be envisioned as a portfolio of assets, where the assets represent divisions, individual lines of business, or separate projects undertaken by the firm. In this conceptualization, the firm's overall market beta coefficients are weighted averages of the beta coefficients of the separate divisions of lines of business. In theory, the weight on each divisional or line of business beta is the market value of the division divided by the market value of the firm as a whole. However, because individual business units are not publicly traded, it is not possible to use market value

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[8]We also considered estimating multi-factor models based upon arbitrage pricing theory (APT) as developed by Ross (1976). Like the FF3F model, APT is less restrictive than the CAPM in that it allows for multiple factors rather than a single market factor. Unlike the CAPM, it does not require capital market equilibrium, only the absence of arbitrage opportunities. The APT formula has the same form as equation (3), i.e., it is the sum of a series of beta coefficients multiplied by risk factors. There is no set number of factors and the factors may or may not include the CAPM premium for systematic market risk. Although APT is an important model, we do not estimate APT costs of capital in this paper. Among the practical limitations of the APT is that it places heavier demands on the data than the CAPM or FF3F methods and thus is more difficult to implement for industries such as insurance where the number of traded stocks is relatively low. In addition, the factors that comprise empirical versions of the arbitrage pricing model are often difficult to interpret economically (i.e., they are developed using factor analysis rather than being determined a priori by theoretical arguments), and the factor risk premia are often difficult to estimate. Moreover, the generalization of the methodology to incorporate industry factors also is not straightforward. Further information on APT can be found in Roll and Ross (1980), Ingersoll (1987), and Campbell, Lo, and MacKinlay (1997). Lee and Cummins (1998) present a recent application of APT to insurance stocks.

weights. Instead, Kaplan and Peterson (1998) recommend using divisional or line of business sales data to represent participation in different industries or activities. We adopt the Kaplan-Peterson approach in this paper.

Specifically, we seek to decompose the overall market beta coefficient (for the CAPM) or coefficients (for the FF3F model) into separate beta coefficients for each industry/line of business in which firms participate. The decomposition is accomplished by performing a cross-sectional regression for a sample of firms with the overall market beta as the dependent variable and a series of weights proxying for the firm's participation in various lines of business as explanatory variables. For example, the regression equation for the CAPM beta is:

$$\beta_i = \sum_{j=1}^{J} \beta_{fj}\, \omega_{ij} + \nu_i \qquad \textbf{(4)}$$

where β_i = the firm's overall market beta coefficient,

β_{fj} = the full-information beta for industry j,

ω_{ij} = firm i's industry participation weight for industry j, and

ν_i = random error term for firm i.

Analogous regressions are used to estimate full-information betas for the FF3F method. The ω_{ij}, j = 1, 2, . . ., J for firm i, which sum to 1.0, reflect the firm's relative exposure to risks from each line of business. The β_{fj}, which vary by industry but not by firm, are designed to capture the impact that any particular line of business is expected to have on the overall riskiness and hence the beta coefficient of the firm. The key idea reflected in the FIB technique is that equation (4) can be used "out of sample" to estimate the overall beta coefficients β_i for non-traded firms or for individual divisions or lines of business. For example, a firm with 100% of its revenues in industry (line of business) j would have an estimated overall beta coefficient: β_i = β_{fj}; and a firm with 50% of its revenues from industries j and k would have an overall beta coefficient: β_i =

$0.5(\beta_{fj} + \beta_{fk})$.

3. Data and Methodology

Data and Sample Selection

To estimate the CAPM, FF3F, and full-information costs of capital, we need data on stock returns and insurer revenues by line of business. This section describes the data sources, sample selection procedures, and data screens employed to construct our sample.

The stock return data for the study were obtained from the University of Chicago's Center for Research on Securities Pricing (CRSP). The data consist of returns on all NYSE, AMEX, and Nasdaq stocks. We obtained the CRSP data for the period 1992-2000, permitting us to estimate costs of capital for the period 1997-2000, because we follow the standard procedure of using 60 monthly observations to estimate the parameters of our cost of capital models. In selecting the stock returns, we employed screening rules that also are standard in the cost of capital estimation literature (e.g., Fama and French 1992, 1997), i.e, we eliminated firms with estimated CAPM beta coefficients greater than 5 in absolute value and also eliminated firms that did not have at least 36 consecutive months of return information prior to June of each year of the estimation period 1997-2000. Excess return data for market systematic risk, size, and financial distress were obtained from Kenneth French's website.[9]

To obtain revenues by line of business, we utilize Compustat's Business Information File (BIF) and data from the National Association of Insurance Commissioners (NAIC). Compustat includes revenue data for firms in various industries, where industries are categorized using the North American Industry Classification System (NAICS). Insurance is included in the finance sector, which has two-digit NAICS code of 52. Within the finance sector, the NAICS system categorizes revenues by industry and sub-industry. There are several insurance sub-categories including property/casualty insurance (NAICS code 524126), property/casualty reinsurance (NAICS code 52413 or 524130), life insurance (NAICS code 524113), and

[9]The url is: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french.

health insurance (NAICS code 524114), and we utilize Compustat revenue data for these insurance lines of business in estimating our models. Within the property/casualty industry, the NAICS system does not further categorize revenues by line of insurance. Consequently, we obtained data on insurance revenues by line from the NAIC annual statement CD-ROMs to supplement the Compustat data.

Estimation Methodology

Our CAPM estimates were obtained using standard procedures, described below; and our estimation approach for the FF3F model follows Fama and French (1992, 1993, 1997). Our estimation approach for the full-information beta (FIB) analysis follows Kaplan and Peterson (1998).

Cost of capital estimation using the CAPM, FF3F, and FIB analyses is conducting using a two-stage approach. In the first stage, returns on specific stocks in the sample are regressed on a market risk factor or factors to obtain separate beta coefficients for each firm. The beta estimation stage may involve more than one step, as in the case of FIB analysis. In the second stage, the beta coefficients are inserted into equations such as (2) and (3) along with the estimated market risk premia to obtain cost of capital estimates for each firm. In the following, we describe more precisely the estimation of cost of capital using the three methods and then discuss our application of the pure play approach.

The CAPM. The easiest of the methodologies to implement is the CAPM. The first stage regression is:

$$r_{it} - r_{ft} = a_i + b_{mi}(r_{mt} - r_{ft}) + e_{it} \quad \textbf{(5)}$$

where β_{mi} = the CAPM beta coefficient for firm i ,

r_{it} = the return on stock I in period t,

r_{ft} = the risk-free rate in period t (30-day Treasury bill yield),

r_{mt} = the return on the market portfolio in period t, and

ϵ_{it} = a random error term for stock i.

The regression produces estimates of the parameters α_i and β_{mi}. The regression sample periods consist of

60 months of data ending in June of each year 1997 through 2000. Firms with less than 60 months of data are included in the analysis as long as they have at least 36 months of data prior to June of each year of the estimation period 1997-2000.

In practice, equation (5) works well for relatively large stocks that are frequently traded. However, it tends to give biased estimates of β_{mi} for stocks that trade infrequently, e.g., stocks that may go for days or weeks at a time with little or no trading. In order to correct for the bias created by infrequent trading, we utilize the *sum-beta approach* that has become standard in this type of analysis (e.g., Scholes and Williams 1977; Dimson 1979). Specifically, we augment the explanatory variables in equation (5) by adding the lagged value of the excess market return variable and estimate the following equation:

$$r_{it} - r_{ft} = a_i + b_{mi0}(r_{mt} - r_{ft}) + b_{mi1}(r_{m,t-1} - r_{f,t-1}) + e_{it} \quad \textbf{(6)}$$

The estimated beta coefficient from this model is the sum of the contemporaneous and lagged beta estimates from equation (6), i.e., the estimated sum beta coefficient is: $\hat{b}_{mi} = \hat{b}_{mi0} + \hat{b}_{mi1}$.[10]

The market excess return factor (r_{mt} - r_{ft}) in equations (5) and (6) is defined as the value-weighted NYSE/AMEX/Nasdaq return less the 30 day T-bill rate lagged one month. This is the standard approach adopted in most cost of capital analyses. The estimated sum beta coefficient from equation (6) is then inserted into equation (2) to obtain the CAPM cost of capital. The market premium for systematic risk, $E(r_m) - r_f$, is estimated as the value-weighted excess return on NYSE/AMEX/Nasdaq stocks from 1926 until June of 2000. We use the same market risk premium in all estimations to focus attention on the differences between methodologies, conditional on the risk premium, rather than varying the risk premium across the estimation period.

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[10]Scholes and Williams (1977) and Dimson (1979) include lead terms in addition to the lagged terms in adjusting for non-synchronous trading. However, these lead terms are not necessary under the assumption that the market return is not contaminated by stale prices and are generally not included in empirical analysis similar to ours. In addition, the methodology used above is consistent with sum beta approach utilized in practice by Ibbotson Associates (see Ibbotson 2001 for further discussion).

The Fama-French 3-Factor Model. The first-stage regression in the Fama-French (FF3F) methodology is a generalization of the CAPM regression:

$$\boldsymbol{r_{it}} - \boldsymbol{r_{ft}} = a_i + b_{mi}(\boldsymbol{r_{mt}} - \boldsymbol{r_{ft}}) + b_{si}\, p_{st} + b_{vi}\, p_{vt} \qquad \textbf{(7)}$$

The returns on stock i, the risk free return, and the return on the market portfolio are the same as in the CAPM regression. As mentioned above, the model also utilizes excess return series representing market excess returns for size and financial distress.

The excess returns for size and financial distress are estimated using the procedure developed in Fama and French (1992).[11] The procedure involves the formation of six portfolios utilizing all stocks traded on the New York Stock Exchange (NYSE), the American Exchange (AMEX), and the Nasdaq. The portfolios are defined as of the end of June in each year of the estimation period, 1997-2000. To estimate the excess return series for firm size, stocks are divided into two portfolios depending upon whether their market capitalization is above or below the median market capitalization for NYSE stocks. These are referred to as the high market capitalization (HMC) and low market capitalization (LMC) portfolios.[12] Likewise, to estimate the expected market risk premium for financial distress, stocks are sorted by their BV/MV ratios and divided into three portfolios depending upon whether their BV/MV ratios are in the range of the top 30 percent of NYSE stocks' BV/MV ratios, the middle 40 percent of NYSE stocks' BV/MV ratios, or the bottom 30 percent of the NYSE stocks' BV/MV ratios. We refer to these three categories as high book-to-market value (HBMV), medium book-to-market value MBMV), and low book-to-market value (LBMV) stocks.

After placing all NYSE, AMEX, and Nasdaq stocks into market capitalization and book-to-market value categories, the next step is to form six return series determined by the intersection of the two market

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[11]As mentioned earlier, the excess returns for systematic market risk, size, and financial distress were obtained from Kenneth French's website.

[12]Because NYSE stocks tend to have relatively large capitalizations, this division places more stocks in the low market capitalization (LMC) portfolio than in the high market capitalization (HMC) portfolio.

capitalization and three book-to-market value categories, yielding six categories of stocks: (1) HMC and HBMV, (2) HMC and MBMV, (3) HMC and LBMV, (4) LMC and HBMV, (5) LMC and MBMV, and (6) LMC and LBMV. The return series are averages of the returns on the stocks in the six categories, where returns are weighted by total market capitalization of each stock to obtain weighted average returns for each of the six portfolios. The final step is to estimate the excess returns for firm size and financial distress, π_{st} and π_{vt}. The estimated value for π_{st} is the average return on the three "small" stock portfolios (portfolios (4), (5), and (6)) minus the average return on the three "large" stock portfolios ((1), (2), and (3)). Similarly, the estimated value for π_{vt} is the difference between the average return on the two "high" market-to-book portfolios ((1) and (4)) minus the average return on the two "low" market-to-book portfolios ((3) and (6)).

It is also important to correct for infrequent trading when estimating the FF3F model. Accordingly, we also calculate FF3F beta estimates using the following regression:

$$\begin{aligned} \boldsymbol{r_{it}} - \boldsymbol{r_{ft}} &= a_i + b_{mi0}(\boldsymbol{r_{mt}} - \boldsymbol{r_{ft}}) + b_{mi1}(\boldsymbol{r_{m,t-1}} - \boldsymbol{r_{f,t-1}}) \\ &\quad + b_{si1} p_{st} + b_{si0} p_{s,t-1} + + b_{vi1} p_{v1t} + b_{vi0} p_{v,t-1} + e_{it} \end{aligned} \quad \textbf{(8)}$$

The sum beta estimates from this model are then defined as: $\hat{b}_{ji} = \hat{b}_{ji0} + \hat{b}_{ji1}$, where j = m for the systematic market risk factor, j = s for the size premium, and j = v for the BV/MV risk premium.

In the second stage of the FF3F methodology, we insert either the betas from equation (7) or the sum beta estimates from equation (8) into equation (3). Also used in this stage are estimates of the long-term average market risk premia π_s and π_v for size and financial distress. As in the case of the market systematic risk factor, the averaging period for the size and financial distress premia is 1926-2000.

The Full-Information Industry Beta (FIB) Approach. The full-information beta (FIB) approach is implemented for both the CAPM and the FF3F models. Because the CAPM can be viewed as a special case of the FF3F model, only the latter model is discussed here.

There are two steps in obtaining beta estimates for any given firm using the FIB approach. The first step is to obtain an estimate of the beta coefficients for each firm in the sample. In the case of the FF3F model, these are the sum beta estimates β_{mi}, β_{si}, and β_{vi} obtained from equation (8). The second step in the FIB method is to conduct cross-sectional regressions with each of the sum beta estimates as dependent variables and industry-participation weights as explanatory variables. The regression, which is conducted with the constant term suppressed, is:

$$\beta_{ji} = \sum_{j=1}^{J} \beta_{fjk} \; \omega_{ik} + \nu_{ji} \qquad \textbf{(9)}$$

where β_{ji} = overall beta estimate of type j for firm i, j = m, s, and v,

β_{fjk} = full-information beta of type j for industry k, j = m, s, and v,

ω_{ik} = industry-participation weight for firm I in industry k, and

ν_{ji} = random error term for firm I, equation j.

Following Kaplan and Peterson (1998), we use revenues by industry to calculate ω_{ik}, so that ω_{ij} = revenues of firm i in industry j divided by total revenues of firm i across all industries. We also break down revenues by line of business within the property-liability insurance industry by using net premiums written as the measure of line of business participation in some of our models.

Equation (9) is estimated using two techniques – unweighted least squares (UWLS) and weighted least squares (WLS). In the WLS estimations, the weight for each firm in a specified cross-sectional regression is the ratio of its market capitalization to the total market capitalization of the firms in the sample i.e., the weight is: $S_i / \sum_{i=1}^{N} S_i$, where S_i = market capitalization of firm i and N = the number of firms in the sample.[13] For both the weighted and unweighted cases, we estimate the three Fama-French regressions using the seemingly unrelated regressions (SUR) procedure to improve estimation efficiency by allowing for cross-

[13]Kaplan and Peterson (1998) suggest using instrumental variables estimation (IV) rather than weighted least squares (WLS). WLS rather than IV is used here because IV estimation is based on the assumption that the error term in equation (9) is homoskedastic, whereas we consider the assumption of heteroskedasticity to be more appropriate. However, WLS and IV give the same point estimates of the coefficients so the choice only affects the standard errors. Robustness checks revealed that the conclusions of our analysis do not differ materially when IV estimation is used.

equation correlations among the regression error terms. The weighted and unweighted FIB regressions for the CAPM are conducted using ordinary least squares.

When UWLS is used to estimate (9) and the corresponding CAPM equation, the β_{fjk} are interpreted as equally-weighted average industry specific betas. When WLS is used, the β_{fjk} represent market value weighted industry betas (Kaplan and Peterson 1998). The equally-weighted results are useful in obtaining an indication of the betas for the average firm in an industry, whereas the market value weighted (WLS) results are a more useful indicator of the overall cost of capital for an industry.

Consistent with Kaplan and Peterson (1998), we estimate full-information equity betas rather than asset betas. The use of equity betas incorporates the assumption that all firms in an industry have an optimal capital structure and that the firms in the industry are operating at or close to the optimum. Although it would be possible to unlever the estimated equity betas, this approach has the limitation of assuming that all industry segments for a given firm have the same leverage (debt capital to equity capital) ratio. However, it has been established that the appropriate allocation of capital to lines of business within an insurance firm is not likely to lead to equal leverage ratios across lines (Myers and Read 2001).

The Pure Play Approach. As mentioned, the pure play approach involves estimating the cost of capital for firms that have a "pure play" in a given industry, i.e., those firms that specialize in a specific industry rather than diversifying across two or more industries. To estimate pure play costs of capital, we selected a sub-sample from our overall sample of publicly traded property-liability insurers, consisting of all firms that self-report their primary business as property-liability insurance, i.e., that have primary NAICS codes of 524126 or 52413. Robustness checks indicated that similar results would be obtained if we used a rule such as requiring that 75 or 100 percent of revenues come from the property-liability insurance industry. We could not use the pure play approach to estimate the cost of capital by line because there are not enough firms in the sample that specialize in individual lines of business.

4. Empirical Results

We begin this section by discussing summary statistics on the industry participation ratios of property-liability insurers. The overall beta and cost of capital estimation results are then presented, followed by a discussion of betas and costs of capital by line. To illustrate the methodology, we conduct the estimation using three separate line of business categorizations: (1) long-tail versus short-tail lines, (2) personal versus commercial lines, and(3) automobile insurance versus workers' compensation versus all other lines. The FIB approach could be applied similarly to obtain costs of capital for other lines and line categories.

Summary Statistics

Table 1 presents the industry-participation statistics for publicly traded firms writing property-liability insurance at year-end 2000. The three primary insurance industry categories are presented at the top of the table, followed by non-insurance industries. There are 117 firms in our sample of publicly traded firms that report writing property-liability insurance in 2000. Seventy-five of these firms identify themselves as being primarily property-liability insurers, and 42 firms identify themselves as primarily participating in some other industry. The table shows that firms participating in the property-liability insurance market also are represented in a variety of other industries. The most common industry is "finance excluding insurance," which includes activities such as mutual fund management, financial planning, securities brokerage, and consumer lending. Thirty-four of the firms that list their primary industry as property-liability insurance participate in the finance excluding insurance category, and 22 of the firms in the sample that are not primarily property-liability insurers participate in the finance excluding insurance segment. Only a few firms in the sample earn significant revenues from non-financial industries.

Overall Costs of Capital

In all of the cost of capital estimates presented in this paper, we use as the risk-free rate the 30 day Treasury-bill rate in December 2000. Likewise, as the expected risk-premia for systematic market risk, size, and financial distress, we use the long-run historical (1926 to 2000) market risk premia on

NYSE/AMEX/Nasdaq stocks from Kenneth French's web site. We use the same risk-free rate and risk premia for all cost of capital estimates to focus on the impact of the models and the beta coefficients on the cost of capital, holding constant the risk-free rate and market risk premia.

The capital asset pricing model (CAPM) beta and sum-beta estimates for property-liability insurers are summarized in Table 2. The table gives the average beta and sum-beta by market capitalization size quartile for each year of the estimation period. As expected, the sum-beta coefficient estimates are consistently larger than the ordinary beta coefficients. For the sample as a whole, the average beta is 0.677 and the average sum-beta is 0.836. Thus, property-liability insurers on average tend to be characterized by infrequent trading, such that it is important to use sum betas to obtain accurate costs of capital for this industry. Interestingly, the quartile results do not show that large insurers consistently have smaller betas than small insurers, contrary to the usual finding for large and small stocks in general. In part, this is because the size difference between the average large and small property-liability insurers is not as high as for large and small stocks in general, i.e., in year 2000 the average P&L insurer in the largest size quartile is approximately half as large as the average firm in that same quartile.

Table 3 provides the overall beta and sum-beta estimates based on the Fama-French Three Factor (FF3F) method. The beta coefficients for systematic market risk, firm size, and financial distress (BV/MV) are shown by quartile and year of the sample period. On average, the market systematic risk factor has a higher beta coefficient than the BV/MV factor, and the firm size factor has the lowest beta coefficient. For the sample as a whole, the market beta is 0.98, the size beta is 0.386, and the financial distress beta is 0.813. Again, the sum beta estimates are larger than the estimates without the sum beta adjustment, although the differences are not as large as for the CAPM estimates in Table 2.

Comparing our results to the results in Fama and French (1997), we find that our market beta and size beta estimates for property-liability insurers are about the same as the all-industry averages for these two parameters in Fama and French (1997), suggesting that property-liability insurance stocks are about average in terms of their sensitivity to systematic market risk and firm size. However, our financial distress betas, which average 0.813, are substantially larger than the Fama-French all-industry average of 0.02 for this parameter.[14] This result suggests that property-liability stock returns are much more sensitive to financial distress than stocks in general and that financial distress carries a significant cost of capital penalty for property-liability insurers.[15]

Full-Information Costs of Capital

The full-information CAPM beta coefficients for property-liability insurance, life insurance, health insurance, non-insurance finance, and all other industries are shown in Table 4. To obtain the FIB estimates shown in the table, we performed the CAPM full-information regression on all 2-digit NAICS industries using all firms appearing in Compustat that met our sample selection criteria. The dependent variable in the regression is the vector of sum-beta estimates obtained from equation (6). We conducted the FIB estimation separately by year and also conducted a panel data regression including the data from all four years of the sample period in a single regression. Both equally weighted and market value weighted averages are shown in the table. The equally weighted averages provide an indication of the beta for the average insurer, whereas the market value weighted averages provide an indication of the systematic risk sensitivity for the industry as a whole. We focus most of the discussion on the panel data results, but the annual averages are generally quite similar.

Based on the panel regression results, the equally weighted CAPM beta coefficient for the property-liability insurance industry is 0.86 and the value weighted beta is 0.84, i.e., the industry is slightly less risky

[14]Our estimates of the size and financial distress beta for property-liability insurers are also much larger than the Fama-French estimates of these parameters for the insurance industry, 0.09 and 0.06, respectively. However, their definition of the insurance industry is much broader than ours, including life and health insurers as well as property-liability insurers.

[15]Additional evidence of a significant "flight to quality" effect for property-liability insurers is presented in Cummins and Lewis (2003). They analyze a sample of insurers that sustained losses due to the September 11, 2001 World Trade Center terrorist attack and show that stock prices for insurers with high financial ratings rebounded quickly following the attack, whereas stock prices for lower-rated insurers remained depressed.

than stocks in general, which have an average beta coefficient of 1.0. The equally-weighted property-liability industry beta based on the panel estimation model is significantly less than the betas of the health insurance and "all other industries" categories but not significantly different from life insurers or finance excluding insurance. Based on the value-weighted estimates, the property-liability betas are significantly smaller than those of all other industry segments shown in the table. Hence, there is strong evidence that property-liability insurance has lower CAPM systematic risk on average than other industries.

The CAPM costs of capital corresponding to the beta estimates are shown in the last two panels of Table 4. Both the equally weighted and the value weighted estimates suggest that the FIB CAPM cost of equity capital for property-liability insurers is approximately 13.1 percent. Based on the value-weighted estimates, the CAPM cost of capital for property-liability insurers is less than that for life insurers (14.5 percent), health insurers (16.1 percent), financial firms excluding insurers (17.0 percent), and all other industries (14.2 percent).

The FF3F full-information beta estimates and costs of capital for property-liability insurers are shown in Table 5. The estimates in Table 5 incorporate the sum-beta adjustment. The beta coefficients shown in the table are the coefficients of the property-liability industry participation factor in the cross-sectional regressions of the market systematic risk betas (β_{mi}), the small minus big firm capitalization betas (β_{si}), and the high minus low BV/MV betas (β_{vi}), respectively, on the market participation ratios for all Compustat firms meeting our selection criteria. Because the FIB estimates focus only on the property-liability insurance industry component of insurer betas, the numbers differ from those in Table 3, which presents betas for the entire firm rather than specific business lines.

Based on the equally weighted panel regression results for property-liability insurers (panel A of Table 5), the systematic market risk factor is about the same as the financial distress (high-low BV/MV) factor (1.08 and 1.04, respectively). Based on the property-liability insurer value-weighted results (panel C), the financial distress factor is less than the systematic market risk factor (0.686 versus 1.125 based on the panel regression estimates). This suggests that the stock prices of larger insurers are less sensitive to financial distress than those of smaller insurers, as expected if larger firms are more diversified and have better access to capital. The size factors are much smaller than the systematic market risk and financial distress factors for property-liability insurers. The equally weighted panel estimate is around 0.5 and the value-weighted averages are negative (-0.218), suggesting that the small-stock effect does not necessarily apply to the property-liability insurance market as a whole.

Panels B and D of Table 5 show the equally weighted and value weighted FF3F betas for all other industries (excluding property-liability insurance). Based on both the equally weighted and value weighted results, the average financial distress (High-Low Book/Market) beta for property-liability insurers is substantially larger than for average firms in other industries. This provides further evidence that property-liability stock returns are much more sensitive to financial distress than stocks in general and that financial distress carries a significant cost of capital penalty for property-liability firms. The firm size betas are smaller for property-liability insurers than for average firms in other industries, providing further evidence that the size effect is less pronounced for property-liability insurers than for the stock market in general.

The FF3F equally weighted and value weighted cost of capital estimates for property-liability insurers are compared to those for other industries in panels E and F, respectively, of Table 5. Based on the equally weighted results, the cost of capital estimates for property-liability insurance are about the same as for life insurance but significantly larger than for health insurance, finance excluding insurance, and all non-financial industries. Based on the value-weighted results, the cost of capital for property-liability insurance is significantly less than for finance excluding insurance, significantly greater than for all non-financial industries, and not significantly different from life and health insurance.

Perhaps the most important implication of Tables 4 and 5 is that the FF3F costs of capital are substantially larger than the CAPM costs of capital for property-liability insurers. Based on the equally weighted panel estimate results, the FF3F cost of capital for property-liability firms is 21 percent, whereas the CAPM cost of capital is 13.1 percent. Based on the value weighted panel results, the comparison is 18.1 percent for the FF3F method versus 13 percent for the CAPM. The FF3F model leads to higher cost of capital estimates for property-liability insurers than the CAPM for two primary reasons: (1) the FF3F systematic market risk betas are larger than the comparable CAPM betas, and (2) the FF3F model imposes a positive cost of capital premium for financial distress which is not present under the CAPM. The FF3F size premium has an additional positive effect on the cost of capital based on the equally weighted results but has a slight negative effect based on the value weighted results. Clearly, controlling for factors other than systematic market risk makes a significant difference, suggesting that property-liability insurers relying on the CAPM may be significantly under-estimating the cost of capital.

Table 6 compares the CAPM and FF3F costs of capital for property-liability insurers to the pure play estimates. Recall that the pure play estimates were obtained by restricting the sample to firms that self-report property-liability insurance as their primary industry. Focusing on the annual average results, the pure play costs of capital are slightly smaller than the full-information costs of capital, for all methods shown in the table except the market value weighted FF3F results, where the pure play cost of capital is slightly larger than the FIB result. This general pattern is contrary to the pattern in most other industries, where the pure play estimates tend to exceed the full-information estimates (Kaplan and Peterson 1998), possibly because of the somewhat atypical distribution of firms by size in the property-liability insurance industry. As in the case of the FIB costs of capital, the pure play CAPM estimates are significantly lower than the FF3F estimates, reinforcing the conclusion that focusing on the CAPM alone is likely to underestimate the true cost of capital.

Costs of Capital By Line

In this section, we illustrate the use of the FIB method to estimate the cost of capital by line of property-liability insurance. The results are based on regressions where we replace the Compustat industry-participation variable for property-liability insurers with two or more variables representing line of business distribution within the property-liability insurance industry. For example, if an insurer has its business equally distributed among three lines of insurance and has 75 percent of its total revenues from property-liability insurance, we would replace the 75 percent industry participation ratio with three line of business participation ratios, each equal to 25 percent. As mentioned above, the line of business data are from the NAIC regulatory annual statement files.[16]

The first by-line cost of capital results are presented in Table 7, which shows the full-information CAPM sum-beta cost of capital estimates for short and long-tail lines.[17] Although the equally-weighted beta estimates and costs of capital do not differ significantly between short-tail and long-tail lines, the market-value weighted results are significantly different. For example, the panel regression value-weighted cost of capital for short-tail lines is 17.4 percent whereas the four-year average cost of capital for long-tail lines is 11.1 percent. These results suggest that the short and long-tail costs of capital are about the same for the average insurer but that the long-tail cost of capital is noticeably smaller than the short-tail cost of capital for the property-liability insurance market as a whole.

Table 8 shows the FF3F full-information beta estimates and costs of capital for short-tail and long-tail lines. To conserve space, the beta estimates are provided only for the value-weighted methodology, whereas costs of capital are shown for both the equally-weighted and value-weighted models. Consistent with Table 7, both the equally-weighted and value-weighted results in Table 8 show that the cost of capital is lower for

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[16]We calculate the property-liability insurance line-of-business participation weights by multiplying the percentage of the firm's statutory premiums in a particular line of insurance by the firm's overall proportion of net sales in the property-liability insurance industry calculated using the consolidated GAAP revenue data reported on Compustat. An alternative way to calculate the property-liability line-of-business participation weights would have been to divide the firm's total statutory premiums in the particular line of insurance by the total net sales for the firm as reported on Compustat. We do not use this latter method owing to the differences that exist between GAAP and Statutory accounting rules and because the NAIC data files only contain information on the insurer's domestic U.S. business while the GAAP consolidated data contains net sales of the insurer's domestic and foreign subsidiaries. Our preferred method makes the assumption that the insurer's foreign property-liability insurance business is divided among the various property-liability lines of insurance in proportions similar to its domestic business.

[17]Short-tail lines of insurance includes property coverages (e.g. fire, allied lines, homeowners multi-peril, automobile physical damage etc.), all accident and health coverages and all financial guaranty businesses (fidelity, surety, mortgage guaranty, etc.). Long-tail business includes all liability insurance coverages (other liability, products liability, personal and commercial automobile liability) and all reinsurance.

long-tail lines than for short-tail lines. The panel regression short-tail and long-tail costs of capital are 19.4 percent versus 17.3 percent based on the equally weighted results and 25.6 percent versus 13.1 percent based on the value weighted results, although the difference is statistically significant only in the value-weighted case. Therefore, it appears that more highly capitalized insurers can write long-tail lines of insurance at much lower costs of capital than smaller insurers, perhaps because of their better diversification, better access to capital, and greater ability to withstand large loss shocks.

The finding that long-tail lines have lower costs of capital than short-tail lines seems to be contrary to the conventional wisdom in the insurance industry that long-tail lines are generally riskier than short-tail lines.[18] One possible explanation for this finding is that the market value of liabilities in long-tail lines is more sensitive to changes in interest rates than is the case for short-tail lines. Because the market values of assets and liabilities tend to move in the same direction in response to interest rate changes, insurers focusing on long-tail lines thus tend to have a “natural hedge” against interest rate risk, which is much less evident in the short-tail lines, possibly leading to lower costs of capital in the long-tail lines. Short-tail lines are also more susceptible to catastrophic losses from events such as hurricanes and earthquakes, providing another possible explanation for the cost of capital difference.

The next set of cost of capital decompositions is based on the personal lines versus the commercial lines of property-liability insurance.[19] The full-information CAPM beta estimates with the sum beta adjustment for personal and commercial lines are shown in Table 9. The panel regression equally-weighted results show a cost of capital of 13.8 percent for the personal lines and 12.8 percent for the commercial lines,

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[18]Our results are not necessarily inconsistent with the finding by Cummins and Lamm-Tennant (1994) that the cost of capital is higher for commercial long-tail lines than for all other lines. As reported below, our results show a higher cost of capital for commercial lines than for personal lines, so it is difficult to say whether the Cummins-Lamm-Tennant finding is driven by commercial lines or long-tail lines (they include only a single business mix variable representing commercial long-tail lines). Additionally, comparison between our results and theirs may not be meaningful, given that their sample period ended in 1989.

[19]Personal lines of insurance includes homeowners, farmowners, earthquake, personal automobile liability and automobile physical damage. All other lines of insurance are considered commercial lines.

whereas the ordering is reversed in the value weighted estimates (11.7 percent for personal lines and 13.6 percent for commercial lines). The difference is statistically significant for the value weighted but not for the equally weighted results. Thus, for the average insurer, the cost of capital is slightly higher for personal lines, but for the market as a whole the cost of capital is higher for commercial lines. This may indicate that the types of commercial business written by larger insurers (e.g., national and multi-national accounts) are more risky than those written by smaller insurers, which tend to focus on local or regional risks. In addition, it may reflect the superior ability of larger insurers to cover catastrophic personal lines property risks because of their better capitalization.

The full-information betas and costs of capital for personal versus commercial lines based on the Fama-French methodology are shown in Table 10. As with the CAPM results, the equally weighted cost of capital estimates in Table 10 imply that the cost of capital for the average insurer is slightly larger for personal lines than for commercial lines (23.1 versus 19.5 percent based on the panel regression). However, the value weighted results show the opposite relationship, costs of capital of 16.3 percent versus 18.8 percent based on the panel regression. These results thus provide additional evidence to suggest that the commercial lines have a higher cost of capital than the personal lines for the market as a whole but not for insurers on average.

The final set of cost of capital decompositions is based on the subdivision of property-liability insurance into automobile insurance, workers' compensation, and all other property-liability lines combined. This line breakdown was chosen to focus on the two most heavily price-regulated lines – automobile and workers' compensation insurance.[20] The CAPM sum-beta results are reported in Table 11. Based on the equally weighted panel estimate results, the cost of capital for automobile insurance is slightly higher than for workers' compensation (13.6 percent versus 13.3 percent), although this difference is not statistically

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[20]Automobile insurance includes premiums written in personal and commercial automobile liability insurance and in automobile physical damage. Further decomposition of the automobile insurance line of business showed that personal automobile liability (the most heavily regulated automobile insurance line) had higher costs of capital than automobile insurance in the aggregate (results available from the authors). Data to decompose automobile physical damage into personal and commercial components are not available in our data source.

significant. Based on the value-weighted results, the cost of capital for automobile insurance is less than for workers' compensation insurance – 11.3 percent versus 13.4 percent, although again the difference is not statistically significant. The cost of capital for all other property-liability (P&L) lines of business is not statistically different from the costs of capital of automobile and workers' compensation insurance based on the equally weighted results, but automobile insurance has a significantly lower cost of capital than all other lines based on the value weighted results. The conclusions to be drawn from Table 11 are that the CAPM costs of capital are about the same for automobile and workers' compensation insurance but that the value weighted (market wide) cost of capital for automobile insurance is significantly lower than for all other lines combined.

Another important inference from Table 11 is that the market wide (value weighted) cost of capital for automobile insurance is significantly lower than the cost of capital for the average insurer for this line. This result illustrates one of the hazards of insurance price regulation, which tends to be based on industry-wide costs of capital rather than costs of capital by firm. As Table 11 indicates, basing prices on industry-wide results could lead to significant pricing errors for many firms in the industry.

The FF3F full-information beta and cost of capital estimates for automobile insurance, workers' compensation, and all other lines are presented in Table 12. As in Tables 8 and 10 only the value-weighted beta estimates are shown in order to conserve space. However, both equally-weighted and value-weighted costs of capital are shown in the table. The results in Table 12 show that the FF3F method again leads to cost of capital estimates that are significantly higher than the CAPM cost of capital estimates (Table 11). For example, the equally-weighted panel estimate costs of capital are 22.3 percent for automobile insurance, 19.6 percent for workers' compensation, and 19.8 percent for all other lines, compared to 13.6 percent for auto, 13.3 percent for workers' compensation, and 12.7 percent for all other lines based on the CAPM. The value-weighted FF3F estimates are also higher than those for the CAPM.

The results in Table 12 also have important implications for price regulation. The results suggest that failure to recognize sources of risk other than the CAPM market systematic risk factor could lead to significant underpricing in regulated lines. In addition ,the results reinforce the conclusion based on Table 11 that the industry-wide cost of capital is significantly lower than the average-firm cost of capital for automobile insurance. Thus, basing prices on industry-wide costs of capital is likely to be value-destroying for the average firm in the industry.

5. Conclusions

This paper investigates the estimation of the cost of equity capital for property-liability insurers using a relatively new methodology, the full-information beta approach. The method is designed to obtain the cost of capital for a division or line of business of a firm, where the divisions (business lines) of the firm are not publicly traded. The procedure is to obtain the beta coefficients for a sample of firms and then to regress the betas cross-sectionally against variables measuring the firm's business composition across industries. The business composition variables used in this study are the ratios of the revenues coming from each industry divided by total revenues from all industries. The estimated regression coefficients are interpreted as full-information betas.

We obtain beta coefficient estimates using two principal cost of capital models in order to implement the full information beta approach – the capital asset pricing model (CAPM) and the Fama-French three-factor model (FF3F). The CAPM includes a single risk factor representing the firm's exposure to systematic market risk. The FF3F model augments the systematic risk factor by adding factors for firm size (total market capitalization) and the financial distress of the firm, proxied by the ratio of the book value (BV) of equity to the market value (MV) of equity. Based on prior empirical research, firm size is expected to be inversely related to the cost of capital, and the BV/MV ratio is expected to be positively related to the cost of capital. In estimating the beta coefficients for the CAPM and the FF3F method, we utilize the sum-beta procedure designed to adjust for the problem of infrequent trading. This adjustment is especially important for the property-liability insurance industry because many insurance stocks are characterized by infrequent trading.

To estimate the full-information betas for the property-liability insurance industry, we utilize a sample consisting of all Compustat firms meeting our sampling criteria, for the estimation period 1997-2000. The sample includes 172 publicly traded firms writing property-liability insurance. Industry participation variables are included for all two-digit industries defined by the North American Industry Classification System (NAICS). The coefficient of the industry-participation ratio for a particular industry is then interpreted as the full-information beta coefficient for that industry. For the CAPM, only one FIB regression is conducted, with the market systemic risk factor (beta) as the dependent variable. For the FF3F method, three FIB regressions are estimated, one for each of the three factors in the Fama-French model.

In the first set of full-information beta regressions considered in the paper, we estimate the full-information betas for the entire property-liability insurance industry using only Compustat data to obtain the industry-participation ratios. In the second set of regressions, we utilize data from the National Association of Insurance Commissioners to break down the revenues of property-liability insurers by line of insurance. We estimate full information betas for three different insurance-line groupings – (1) long-tail versus short-tail lines, (2) personal versus commercial lines; and (3) automobile insurance, workers' compensation insurance, and all other lines

The primary conclusions of the paper are the following:

1. It is important to use the sum beta technique to control for infrequent trading when estimating betas for the property-liability insurance industry. Failure to adjust for this problem is likely to lead to under-estimation of the cost of capital.

2. The cost of capital estimates from the FF3F method are generally higher than the estimates based on the CAPM. Hence, failure to adjust for firm size and financial distress could lead to significant under-estimation of the cost of capital.

3. The cost of capital varies significantly by line of insurance and also varies between large and small insurers. Thus, it is important to use firm and line specific costs of capital in applications such as project selection and capital allocation.

4. Value-weighted estimates of the cost of capital often differ significantly from equally weighted estimates. This suggests that basing price regulation on industry-wide results rather than costs

of capital by firm may lead to significant pricing errors for many firms in the industry.

In general, we believe that the full-information beta approach provides a reliable method for estimating costs of capital by line for property-liability insurers. The method is likely to obtain the most reliable results if it is used with the sum beta adjustment and the FF3F method. The CAPM cost of capital with sum beta adjustment also may be useful at least as a reasonability check on the FF3Fmethod.

Full-information betas can be used by insurers in a variety of contexts, including the allocation of capital by line of business, estimation of risk adjusted returns on capital (RAROC), insurance pricing, and decision making about entering or exiting lines of business. Full-information costs of capital also could be used to evaluate potential merger and acquisition transactions. Another important advantage is that the full-information model can be used to estimate the cost of capital for insurers that do not have traded equity, including mutuals, reciprocals, and untraded stock insurers owned by publicly traded insurers, financial services firms, or conglomerates.

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Table 1

Sources of Revenue Across Industries for Firms Writing Property-Liability Insurance: 2000

Table displays the total revenue across industries for all firms writing property-liability insurance during 2000. Industry classifications were derived using the North American Industry Classification System (NAICS). The firm's self-reported primary NAICS code was used to classify the firms as either predominantly P&L insurers or as firms whose primary business line was something else. Revenue amounts are reported in $millions. The number of firms with positive revenues in a given industry segment are reported in parantheses. Source: COMPUSTAT Business Information File.

2 - Digit NAICS	Industry Description	Primarily Non-P&L Insurer		Primarily P&L Insurer	
-	Property/Liability Ins. and Reinsurance*	$ 71,639.26	(42)	$ 134,218.70	(75)
-	Health Insurance*	4,050.54	(5)	9,283.92	(2)
-	Life Insurance*	93,430.59	(10)	16,664.25	(17)
72	Accommodation and Food Services	-	-	351.06	(1)
71	Arts, Entertainment, and Recreation	-	-	32.68	(1)
62	Health Care and Social Assistance	4.96	(1)	-	-
61	Education Services	1,856.83	(1)	-	-
56	Administrative Support, Waste Management and Remediation	626.64	(2)	-	-
54	Professional, Scientific, and Technical Services	488.09	(3)	350.29	(2)
53	Real Estate and Rental and Leasing	5,078.98	(4)	8.20	(1)
52	Finance Excluding Insurance*	26,456.14	(22)	5,518.24	(34)
51	Information	326.12	(4)	3.55	(1)
48	Transportation and Warehousing	99.50	(1)	31.52	(1)
45	Retail Trade 2	332.43	(1)	-	-
44	Retail Trade 1	1,402.19	(1)	-	-
42	Wholesale Trade	-	-	378.60	(3)
33	Manufacturing - Heavy Ind., Machinery, Electronic & Computer	2,750.82	(2)	-	(1)
32	Manufacturing - Light Commercial Products	1,607.42	(1)	63.98	(1)
31	Manufacturing - Consumer Items	803.50	(1)	4,302.81	(2)
23	Construction	13.15	(1)	155.68	(2)
22	Mining	-	-	1,054.52	(2)

Note: Property-liability insurers and reinsurers have NAICS codes 524126 and 52413, respectively. Life insurers have NAICS code 524113. Health insurers have NAICS code 524114. All other NAICS codes under the "Finance and Insurance" heading (2 Digit NAICS code 52) are classified as "Finance Excluding Insurance."

Table 2

Summary Statistics for CAPM Regressions on Property-Liability Insurers

Table shows average CAPM beta for firms which self-identify as property-liability insurers by listing their overall NAICS code as 524126 or 52413. Both beta and sum beta regressions are conducted for each firm (equations (5) and (6)). The beta regression is:

$$(R_i - R_f) = a + \beta(R_m - R_f) + e$$

where R_i is the return on firm i, R_f is the one-month Treasury bill rate observed at the beginning of the month, and R_m is the value-weighted market return on all NYSE, AMEX, and NASDAQ stocks. The "Sum β" model adjusts for non-synchronous trading by adding to the regression the excess market return variable lagged one time period. The reported statistic equals the sum of the contemporaneous and lagged beta estimates. The data period for each year end on June 30. Estimates are calculated using the previous 60-months of returns.

Year	Market Cap Quartile	No. P&L Insurers	Average b	Average Sum b
1997	Small	21	0.646	0.893
	2	21	0.861	1.144
	3	21	0.709	0.809
	Big	22	0.820	0.932
	Total	85	0.760	0.944
1998	Small	18	0.632	0.926
	2	19	0.687	0.908
	3	19	0.652	0.811
	Big	19	0.917	0.999
	Total	75	0.723	0.911
1999	Small	19	0.570	0.812
	2	19	0.616	0.677
	3	19	0.642	0.736
	Big	19	0.690	0.746
	Total	76	0.629	0.743
2000	Small	18	0.316	0.631
	2	18	0.654	0.763
	3	18	0.642	0.696
	Big	19	0.712	0.817
	Total	73	0.583	0.728
Grand Total		309	0.677	0.836

Table 3

Beta and Sum-Beta Estimates for Fama-French Three-Factor Regressions on Property-Liability Insurers

Table shows average regression coefficients from Fama-French 3 Factor Model for firms which self-identify as property-liability insurers by listing their overall NAICS code as 524126 or 52413. Both beta and sum-beta regressions (equations (7) and (8)) are estimated for each firm. The beta regression is as follows:

$$(R_i - R_f) = \alpha_i + \beta_i(R_m - R_f) + s_i SMB + h_i HML + \varepsilon_i$$

where R_i is the return on firm i, R_f is the one-month Treasury bill rate observed at the beginning of the month, and R_m is the value-weighted market return on all NYSE, AMEX and Nasdaq stocks. The factors SMB and HML are determined as follows. At the end of June of each year, all NYSE, AMEX and Nasdaq stocks are allocated to two groups (small or big) based upon whether their market capitalization is less than or greater than median market capitalization for NYSE stocks. Stocks are also sorted into three book-to-market groups (low, medium, high) based upon the breakpoints for the bottom 30 percent, middle 40 percent, and top 30 percent values of book equity-to-market capitalizations for NYSE stocks. Six size-BE/ME portfolios (SL, SM, SH, BL, BM, BH) are then formed using the inter-sections of the breakpoints defined above. Value-weighted monthly returns on the six portfolios are calculated from July to the following June. SMB is the difference, each month, between the average returns on the three small-stock portfolios (SL,SM,SH) and the three big-stock portfolios (BL,BM,BH). HML is the difference each month between the average of the returns on the two high BE/ME portfolios (SH and BH) and the two low BE/ME portfolios (SL and BL). The "Sum Beta" model adjusts for non-synchronous trading by including each factor and each factor lagged one time period. The reported statistic equals the sum of the contemporaneous and lagged regression coefficients. Estimates are calculated using the previous 60-months of returns. More detail on the construction of factors SMB and HML can be foud in Fama and French (1993). The factors are available on French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

Year	Market Cap Quartile	No. P&L Insurers	b_m	b_s	b_v	Sum b_m	Sum b_s	Sum b_v
1997	Small	21	0.875	0.463	0.624	1.189	0.766	1.086
	2	21	1.080	0.610	0.743	1.205	0.785	0.834
	3	21	0.976	0.397	0.668	0.978	0.093	0.608
	Big	22	1.060	0.130	0.673	1.080	-0.220	0.355
	Total	85	0.998	0.397	0.677	1.112	0.349	0.716
1998	Small	18	0.765	0.652	0.538	1.091	1.346	1.328
	2	19	0.928	0.613	0.735	0.999	0.716	0.765
	3	19	0.989	0.412	0.850	0.992	0.349	0.982
	Big	19	1.253	0.175	0.983	1.238	-0.018	0.778
	Total	75	0.986	0.460	0.779	1.080	0.589	0.958
1999	Small	19	0.650	0.551	0.453	0.735	1.055	0.723
	2	19	0.805	0.517	0.633	0.651	0.751	0.578
	3	19	0.965	0.465	0.953	1.023	0.528	1.244
	Big	20	1.115	0.073	1.023	1.108	0.150	1.056
	Total	77	0.887	0.397	0.769	0.882	0.615	0.902
2000	Small	18	0.679	0.624	0.972	1.069	0.742	1.385
	2	19	1.060	0.536	0.990	1.038	0.635	1.059
	3	19	1.117	0.178	1.041	1.053	0.441	1.277
	Big	19	1.322	-0.174	1.183	1.167	0.105	1.180
	Total	75	1.050	0.286	1.048	1.082	0.477	1.223
Grand Total		312	0.980	0.386	0.813	1.040	0.503	0.942

Table 4

Full Information CAPM Beta Estimates with Sum Beta Adjustment By Industry Category

Table displays full information CAPM beta estimates for property-liability insurance, life insurance, health hnsurance, finance excluding insurance, and all other industries. The full-informaton beta is estimated from the following cross-sectional regression

$$\beta_i = \Sigma\, \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is the equity beta estimated using equation (6) for firm i, $\beta full_i$ is the estimated full-information beta for industry j, W_{ij} is the percent of firm i's net sales in industry j. The regression is estimated by OLS (Equally weighted) and via wieghted least squares (Market Weighted). The latter is used so we can obtain market-capitalization weighted industry full-information betas. The weight is equal to the market capitalization of firm i relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks. Any firm with an estimated beta greater than 5 or less than -5 is removed from the sample. The full-information regression was estimated separately for each calendar year and as a pooled regression across all four years. The risk-free rate of interest used to estimate the cost of equity capital was the published 30 day T-bill rate in December 2000, 5.88 percent. The long-run historical market risk premium as of December 2000 was 8.49 percent (Ibottson, 2001).

	1997	1998	1999	2000	Average	Panel Estimate
Beta (Equally Weighted)						
Property-Liability Insurance	0.939	0.931	0.769	0.759	0.849	0.856
	(0.109)	(0.108)	(0.099)	(0.103)		(0.053)
Life Insurance	0.974	0.952	0.821	0.785	0.883	0.897
	(0.182)	(0.198)	(0.193)	(0.190)		(0.095)
Health Insurance	0.722	1.023	1.584	1.160	1.122	1.096
	(0.203)	(0.229)	(0.190)	(0.214)		(0.105)
Finance (Excluding Insurance)	0.915	0.822	0.868	0.782	0.847	0.847
	(0.060)	(0.057)	(0.050)	(0.190)		(0.027)
Average All Non-Financial Industries	1.108	1.082	1.099	1.057	1.087	1.091
F-Test: $\beta_{P\&L} = \beta_{Life}$	0.050	0.070	0.030	0.010		0.200
F-Test: $\beta_{P\&L} = \beta_{Health}$	0.750	0.230	13.80 ***	2.700		4.40 **
F-Test: $\beta_{P\&L} = \beta_{Finance(Excluding\ Ins)}$	0.010	0.310	0.580	0.010		0.000
F-Test: $\beta_{P\&L} = \beta_{Average\ All\ Non\text{-}Financial\ Industries}$	2.450	2.530	9.24 ***	7.06 ***		18.65 ***
Beta (Market Value Weighted)						
Property-Liability Insurance	0.847	0.858	0.764	0.964	0.858	0.843
	(0.054)	(0.050)	(0.067)	(0.085)		(0.031)
Life Insurance	1.114	0.971	0.880	1.057	1.006	1.012
	(0.097)	(0.088)	(0.104)	(0.136)		(0.059)
Health Insurance	1.007	1.434	1.324	1.150	1.229	1.208
	(0.103)	(0.112)	(0.113)	(0.141)		(0.053)
Finance (Excluding Insurance)	1.327	1.199	1.365	1.330	1.305	1.309
	(0.036)	(0.031)	(0.029)	(0.032)		(0.016)
Average All Non-Financial Industries	1.026	0.983	0.968	0.987	0.991	0.986
F-Test: $\beta_{P\&L} = \beta_{Life}$	5.97 **	2.78 *	0.940	0.260		9.23 ***
F-Test: $\beta_{P\&L} = \beta_{Health}$	2.490	24.79 ***	18.30 ***	1.150		32.88 ***
F-Test: $\beta_{P\&L} = \beta_{Finance(Excluding\ Ins)}$	55.95 ***	40.42 ***	67.70 ***	15.76 ***		184.75 ***
F-Test: $\beta_{P\&L} = \beta_{Average\ All\ Non\text{-}Financial\ Industries}$	10.09 ***	8.86 ***	8.16 ***	0.020		22.22 ***
Cost of Equity Capital (Equally Weighted)						
Property-Liability Insurance	13.9%	13.8%	12.4%	12.3%	13.1%	13.1%
Life Insurance	14.2%	14.0%	12.9%	12.5%	13.4%	13.5%
Health Insurance	12.0%	14.6%	19.3%	15.7%	15.4%	15.2%
Finance (Excluding Insurance)	13.6%	12.9%	13.2%	12.5%	13.1%	13.1%
Average All Non-Financial Industries	15.3%	15.1%	15.2%	14.9%	15.1%	15.1%
Cost of Equity Capital (Market Value Weighted)						
Property-Liability Insurance	13.1%	13.2%	12.4%	14.1%	13.2%	13.0%
Life Insurance	15.3%	14.1%	13.4%	14.8%	14.4%	14.5%
Health Insurance	14.4%	18.1%	17.1%	15.6%	16.3%	16.1%
Finance (Excluding Insurance)	17.1%	16.1%	17.5%	17.2%	17.0%	17.0%
Average All Non-Financial Industries	14.6%	14.2%	14.1%	14.3%	14.3%	14.2%

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 5

Full Information Fama-French 3-Factor Estimates with Sum Beta Adjustment: Property-Liability Insurance

Table displays full information beta estimates for the Fama-French 3 Factor Model for the property-liability insurance industry. The full-information beta for each factor is the estimated from the following cross-sectional regression

$$\beta_i = \Sigma \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is either the excess market coefficient, the SMB coefficient, or the HML coefficient estimated using equation (8) for firm i, $\beta full_i$ is the estimated full-information coefficient estimate for industry j, Wij is the percent of firm i's net sales in industry j. The regression is estimated by OLS (Equally Weighted) and via weighted least squares (Market Weighted). The latter is used so we can obtain market-capitalization weighted industry full-information betas. The weight is equal to the market capitalization of firm I relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks with an estimated factor coefficient greater than 5 or less than -5 is removed from the sample. The full-information regression was estimated each calendar year and as a pooled regression across all four years. The risk-free rate of interest used to estimate the cost of equity capital was the published 30 day T-bill rate in December 2000, 5.88 percent. The long-run historical premium for the excess market return,the SMB factor, and the HML factor as of December 2000 was 8.49 percent, 2.21 percent, and 4.63 percent respectively.

	1997	1998	1999	2000	Average	Panel Estimate
Panel A: Property-Liability Equally Weighted						
CAPM Beta Factor β_m	1.113	1.099	0.958	1.143	1.078	1.080
	(0.106)	(0.106)	(0.103)	(0.109)		(0.053)
Small - Big Capitalization Factor β_s	0.353	0.586	0.618	0.472	0.507	0.501
	(0.136)	(0.133)	(0.124)	(0.123)		(0.065)
High - Low Book/Market Factor β_v	0.813	1.066	1.026	1.311	1.054	1.040
	(0.139)	(0.169)	(0.153)	(0.155)		(0.077)
Panel B: Average of All Other Industries Equally Weighted[1]						
CAPM Beta Factor β_m	0.873	0.907	0.880	1.083	0.936	0.937
Small - Big Capitalization Factor β_s	0.972	0.940	0.909	0.663	0.871	0.866
High - Low Book/Market Factor β_v	0.185	0.184	0.209	0.585	0.291	0.284
Panel C: Property-Liability Market Value Weighted						
CAPM Beta Factor β_m	1.021	1.131	1.148	1.355	1.164	1.125
	(0.054)	(0.053)	(0.068)	(0.082)		(0.031)
Small - Big Capitalization Factor β_s	-0.387	-0.211	-0.015	-0.126	-0.185	-0.218
	(0.080)	(0.080)	(0.077)	(0.097)		(0.042)
High - Low Book/Market Factor β_v	0.230	0.720	1.020	1.150	0.780	0.686
	(0.085)	(0.106)	(0.102)	(0.139)		(0.054)
Panel D: Average of All Other Industries Market Value Weighted[1]						
CAPM Beta Factor β_m	0.941	0.974	1.010	1.193	1.030	1.003
Small - Big Capitalization Factor β_s	0.337	0.240	0.155	-0.026	0.177	0.186
High - Low Book/Market Factor β_v	0.051	0.101	0.195	0.448	0.199	0.148
Panel E: Industry Cost of Equity Capital Equally Weighted						
Property-Liability Insurance	19.9%	21.4%	20.1%	22.7%	21.0%	21.0%
Life Insurance	20.7%	19.9%	20.0%	21.3%	20.5%	20.5%
Health Insurance	6.3%	13.3%	19.0%	22.0%	15.1%	14.3%
Finance Excluding Insurance	19.4%	18.0%	16.0%	16.7%	17.5%	17.6%
Average All Non-Financial Industries	16.3%	16.5%	16.3%	19.3%	17.1%	17.1%
F-Test: $r_{P\&L} = r_{Life}$	0.100	0.230	0.000	0.240		0.100
F-Test: $r_{P\&L} = r_{Health}$	22.51 ***	5.35 **	0.200	0.040		18.46 ***
F-Test: $\beta_{P\&L} = \beta_{Finance(Excluding\ Ins)}$	0.090	4.02 **	8.18 ***	15.22 ***		19.06 ***
F-Test: $r_{P\&L} = r_{Average\ All\ Non\text{-}Financial\ Industries}$	6.18 **	10.34 ***	9.87 ***	6.46 **		31.11 ***
Panel F: Industry Cost of Equity Capital Market Value Weighted						
Property-Liability Insurance	14.8%	18.4%	20.3%	22.4%	19.0%	18.1%
Life Insurance	23.7%	19.9%	13.7%	13.7%	17.8%	18.8%
Health Insurance	9.9%	17.6%	20.6%	23.5%	17.9%	16.9%
Finance Excluding Insurance	22.3%	23.0%	20.2%	19.5%	21.2%	21.1%
Average All Non-Financial Industries	14.8%	15.1%	15.7%	18.0%	15.9%	15.5%
F-Test: $r_{P\&L} = r_{Life}$	27.89 ***	0.610	12.98 ***	13.11 ***		0.530
F-Test: $r_{P\&L} = r_{Health}$	9.06 ***	0.110	0.030	0.260		1.470
F-Test: $\beta_{P\&L} = \beta_{Finance(Excluding\ Ins)}$	66.88 ***	17.85 ***	0.020	6.29 **		33.01 ***
F-Test: $r_{P\&L} = r_{Average\ All\ Non\text{-}Financial\ Industries}$	0.280	14.74 ***	25.93 ***	12.81 ***		38.29 ***

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 6

Property-Liability Insurer Costs of Capital:

Full-Information Betas Versus the Pure Play Methodology

Table displays the cost of capital for the property-liability industry calculated using the full information beta methodology vers the average cost of capital for firms which self-report their primary business being property-liability insurance (primary NAICS codes 524126 and 52413). The risk-free rate of interest used to estimate the cost of equity capital was the published 30 da T-bill rate in December 2000, 5.88 percent. The long-run historical premium for the excess market return, the SMB factor, a the HML factor as of December 2000 was 8.49 percent, 2.21 percent, and 4.63 percent, respectively

	1997	1998	1999	2000	Average	Panel Estimate
Full Information Beta Methodology Estimates						
Equally Weighted						
CAPM Beta	12.6%	12.2%	11.5%	11.0%	11.8%	11.9%
CAPM Sum Beta	13.9%	13.8%	12.4%	12.3%	13.1%	13.1%
Fama-French	19.2%	19.5%	19.1%	21.3%	19.8%	19.7%
Fama-French Sum Beta	19.9%	21.4%	20.1%	22.7%	21.0%	21.0%
Market Value Weighted						
CAPM Beta	13.8%	13.9%	12.4%	12.8%	13.2%	13.4%
CAPM Sum Beta	13.1%	13.2%	12.4%	14.1%	13.2%	13.0%
Fama-French	17.9%	19.2%	20.4%	22.7%	20.0%	19.5%
Fama-French Sum Beta	14.8%	18.4%	20.3%	22.4%	19.0%	18.1%
Average of Pure Play Estimates						
CAPM Beta	12.3%	12.0%	11.2%	10.8%	11.6%	-
CAPM Sum Beta	13.9%	13.6%	12.2%	12.1%	12.9%	-
Fama-French	18.4%	18.9%	17.8%	20.3%	18.8%	-
Fama-French Sum Beta	19.4%	20.8%	18.9%	21.8%	20.2%	-

Table 7

Full Information CAPM Beta Estimates with Sum Beta Adjustment: Short-Tail Lines vs. Long-Tail Lines

Table displays full information CAPM beta estimates for by-line of property-liability Insurance. Short-tail lines of insurance include all property coverages (fire, allied, etc.), financial and mortgage guaranty, fidelity and surety, etc. Long-tail lines of insurance includes all liability coverages (products liability, other liability, etc.) as well as reinsurance, international etc. See footnote 17 for a complete categorization of all lines. The full-informaton beta comes from the following cross-sectional regression:

$$\beta_i = \Sigma\ \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is the equity beta estimated using equation (6) for firm i, $\beta full_j$ is the estimated full-information beta for industry (line of business) j, wij is the percent of firm i's net sales in industry (line of business) j. The regression is estimated using OLS and via weighted least squares to obtain market-capitalization weighted industry (line of business) full-information betas. The weight is equal to the market capitalization of firm i relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks. Any firm with an estimated beta greater than 5 or less than -5 is removed from the sample. The full-information regression was estimated separately for each calendar year and as a pooled regression across all four years. The risk-free rate of interest is the 30 day T-bill rate in December 2000, 5.88 percent. The long-run historical market risk premium as of December 2000 was 8.49 percent.

	1997	1998	1999	2000	Average	Panel Estimate
Beta (Equally Weighted)						
Short-tail Lines	0.945	0.953	0.882	0.696	0.869	0.876
	(0.232)	(0.223)	(0.203)	(0.221)		(0.111)
Long-tail Lines	0.926	0.895	0.720	0.806	0.837	0.842
	(0.151)	(0.154)	(0.140)	(0.150)		(0.075)
F-Test: $\beta_{Short\text{-}tail} = \beta_{Long\text{-}tail}$	0.000	0.040	0.350	0.130		0.050
Beta (Market Value Weighted)						
Short-tail Lines	1.656	1.400	1.110	1.075	1.310	1.352
	(0.149)	(0.119)	(0.161)	(0.212)		(0.078)
Long-tail Lines	0.525	0.587	0.589	0.925	0.657	0.609
	(0.075)	(0.068)	(0.094)	(0.119)		(0.043)
F-Test: $\beta_{Short\text{-}tail} = \beta_{Long\text{-}tail}$	35.69 ***	28.11 ***	6.08 **	0.290		54.24 ***
Cost of Equity Capital (Equally Weighted)						
Short-tail Lines	13.9%	14.0%	13.4%	11.8%	13.3%	13.3%
Long-tail Lines	13.7%	13.5%	12.0%	12.7%	13.0%	13.0%
Cost of Equity Capital (Market Value Weighted)						
Short-tail Lines	19.9%	17.8%	15.3%	15.0%	17.0%	17.4%
Long-tail Lines	10.3%	10.9%	10.9%	13.7%	11.5%	11.1%

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 8

Full Information Fama-French 3-Factor Estimates with Sum Beta Adjustment: Short-Tail vs. Long-Tail Lines

Table displays full information beta estimates for the Fama-French 3 Factor Model by-line of property-liability insurance. Short-tail lines of insurance include all property coverages (fire, allied, etc.), financial and mortgage guaranty, fidelity and surety, etc. Long-tail lines of insurance include all liability coverages (products liability, other liability, etc.) as well as reinsurance, international, etc. See footnote 17 for a complete categorization of lines. The full-informaton beta comes from the following cross-sectional regression:

$$\beta_i = \Sigma\, \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is either the excess market coefficient, the SMB coefficient, or the HML coefficient estimated using equation (8) for firm i, bfullj is the estimated full-information coefficient estimate for industry (line of business) j, w_{ij} is the percent of firm i's net sales in industry (line of business) j. The regression is estimated via seemingly unrelated regressions both equally weighted and via weighted least squares (market weighted). The latter is used to obtain market-capitalization weighted industry full-informationbetas. The weight is equal to the market capitalization of firm i relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks. Firms with estimated factor coefficients greater than 5 or less than -5 is removed from the sample. The full-information regression is estimated separately for each calendar year and as a pooled regression across all four years. The risk-free rate of interest is the 30-day T-bill rate in December 2000, 5.88 percent. The long-run historical premia for the excess market return, the SMB factor, and the HML factor as of December 2000 were 8.49 percent, 2.21 percent, and 4.63 percent, respectively.

	1997	1998	1999	2000	Average	Panel Estimate
Market Value Weighted Estimates						
Market Systematic Risk Factor						
Short-tail Lines	1.856	1.694	1.467	1.612	1.657	1.680
	(0.149)	(0.128)	(0.164)	(0.212)		(0.079)
Long-tail Lines	0.525	0.713	0.926	1.183	0.837	0.751
	(0.095)	(0.095)	(0.120)	(0.153)		(0.056)
SMB Factor						
Short-tail Lines	-0.233	0.029	0.300	0.026	0.030	0.058
	(0.222)	(0.193)	(0.186)	(0.250)		(0.106)
Long-tail Lines	-0.515	-0.423	-0.252	-0.218	-0.352	-0.426
	(0.142)	(0.143)	(0.136)	(0.180)		(0.074)
HML Factor						
Short-tail Lines	0.757	1.054	1.338	1.514	1.166	1.159
	(0.236)	(0.256)	(0.246)	(0.360)		(0.138)
Long-tail Lines	-0.086	0.498	0.814	0.890	0.529	0.380
	(0.151)	(0.190)	(0.180)	(0.259)		(0.097)
F-Test: $\beta_{Short\text{-}tail} = \beta_{Long\text{-}tail}$	48.01 ***	25.51 ***	4.79 **	0.40		61.49 ***
F-Test: $s_{Short\text{-}tail} = s_{Long\text{-}tail}$	0.76	2.39	3.90 **	0.40		9.35 ***
F-Test: $h_{Short\text{-}tail} = h_{Long\text{-}tail}$	6.04 ***	2.05	2.00	1.28		14.25 ***
Cost of Equity Capital (Equally Weighted)						
Short-tail Lines	16.3%	20.4%	21.0%	20.2%	19.5%	19.4%
Long-tail Lines	17.4%	17.2%	15.1%	19.4%	17.3%	17.3%
F-Test: $r_{Short\text{-}tail} = r_{Long\text{-}tail}$	0.06	0.71	3.55 *	0.05		1.66
Cost of Equity Capital (Market Value Weighted)						
Short-tail Lines	24.6%	25.2%	25.2%	26.6%	25.4%	25.6%
Long-tail Lines	8.8%	13.3%	17.0%	19.6%	14.7%	13.1%
F-Test: $r_{Short\text{-}tail} = r_{Long\text{-}tail}$	27.58 ***	12.77 ***	6.75 ***	2.69 *		53.79 ***

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 9

Full Information CAPM Beta Estimates with Sum Beta Adjustment: Personal Lines vs. Commericial Lines

Table displays full information CAPM beta estimates for personal lines and commericial lines property-liability insurance controlling for non-synchronous trading. Personal lines includes all net premiums written in homeowners, farmowners, earthquake, personal automobile iability, liability, and automobile physical damage. All others lines were considered commerical lines. The full-informaton beta comes from the following cross-sectional regression:

$$\beta_i = \Sigma\, \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is the equity beta estimated using equation (6) for firm i, $\beta full_j$ is the estimated full-information beta for industry (line of business) j, w_{ij} is the percent of firm i's net sales in industry (line of business) j. The regression is estimated using OLS and via weighted least squares to obtain market-capitalization weighted industry (line of business) full-information betas. The weight is equal to the market capitalization of firm i relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks. Any firm with an estimated beta greater than 5 or less than -5 is removed from the sample. The full-information regression was estimated separately for each calendar year and as a pool regression across all four years. The risk-free rate of interest is the 30 day T-bill rate in December 2000, 5.88 percent. The long-run historical market risk premium as of December 2000 was 8.49 percent.

	1997	1998	1999	2000	Average	Panel Estimate
Beta (Equally Weighted)						
Personal Lines	1.114	1.007	0.779	0.734	0.908	0.929
	(0.263)	(0.276)	(0.256)	(0.258)		(0.132)
Commercial Lines	0.839	0.853	0.778	0.778	0.812	0.813
	(0.156)	(0.154)	(0.140)	(0.149)		(0.075)
F-Test: $\beta_{Personal} = \beta_{Commercial}$	0.630	0.180	0.000	0.020		0.450
Beta (Market Value Weighted)						
Personal Lines	0.749	0.736	0.446	0.725	0.664	0.686
	(0.103)	(0.091)	(0.137)	(0.187)		(0.061)
Commercial Lines	0.876	0.875	0.955	1.132	0.959	0.914
	(0.085)	(0.079)	(0.106)	(0.139)		(0.049)
F-Test: $\beta_{Personal} = \beta_{Commercial}$	0.690	1.040	6.50 ***	2.200		6.58 **
Cost of Equity Capital (Equally Weighted)						
Personal Lines	15.3%	14.4%	12.5%	12.1%	13.6%	13.8%
Commercial Lines	13.0%	13.1%	12.5%	12.5%	12.8%	12.8%
Cost of Equity Capital (Market Value Weighted)						
Personal Lines	12.2%	12.1%	9.7%	12.0%	11.5%	11.7%
Commercial Lines	13.3%	13.3%	14.0%	15.5%	14.0%	13.6%

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 10

Full Information Fama-French 3-Factor Estimates with Sum Beta Adjustment: Personal Lines vs. Commercial Lines

Table displays full information coefficient estimates for the Fama-French 3-Factor model for personal lines and commericial lines property-liability insurance. Personal lines include all net premiums written in homeowners, farmowners, earthquake, personal auto liability, and automobile physical damage. All other lines of business wer considered commerical lines. The full-informaton betas come from the following cross-sectional regression:

$$\beta_i = \Sigma \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is either the excess market coefficient, the SMB coefficient, or the HML coefficient estimated using equation (8) for firm i, bfullj is the estimated full-information coefficient estimate for industry (line of business) j, w_{ij} is the percent of firm i's net sales in industry (line of business) j. The regression is estimated via seemingly unrelated regressions both equally weighted and via weighted least squares (market weighted). The latter is used to obtain market-capitalization weighted industry full-information betas. The weight is equal to the market capitalization of firm i relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks. Firms with estimated factor coefficients greaterthan 5 or less than -5 is removed from the sample. The full-information regression is estimated separately for each calendar year and as a pooled regression across allfour years.The risk-free rate of interest is the 30-day T-bill rate in December 2000, 5.88 percent. The long-run historical premia for the excess market return, the SMB factor, and the HML factor as of December 2000 were 8.49 percent, 2.21 percent, and 4.63 percent, respectively.

	1997	1998	1999	2000	Average	Panel Estimate
Market Value Weighted						
Market Systematic Risk Factor						
Personal Lines	0.886	1.029	0.980	1.263	1.040	0.999
	(0.102)	(0.098)	(0.140)	(0.180)		(0.061)
Commercial Lines	1.080	1.141	1.252	1.416	1.222	1.178
	(0.084)	(0.084)	(0.108)	(0.134)		(0.049)
Small - Big Capitalization Factor						
Personal Lines	-0.575	-0.467	-0.114	-0.189	-0.336	-0.430
	(0.153)	(0.147)	(0.159)	(0.213)		(0.081)
Commercial Lines	-0.305	-0.095	0.006	-0.104	-0.124	-0.120
	(0.126)	(0.127)	(0.122)	(0.158)		(0.066)
High - Low Book/Market Factor						
Personal Lines	0.042	0.619	1.330	1.465	0.864	0.632
	(0.162)	(0.196)	(0.210)	(0.307)		(0.106)
Commercial Lines	0.338	0.764	0.805	0.906	0.704	0.697
	(0.134)	(0.168)	(0.162)	(0.228)		(0.086)
F-Test: $\beta_{Personal} = \beta_{Commercial}$	1.66	0.60	1.80	0.33		4.02 **
F-Test: $s_{Personal} = s_{Commercial}$	1.44	2.88 *	0.27	0.07		6.72 ***
F-Test: $h_{Persona} = h_{Commercial}$	1.53	0.25	0.16	1.53		0.17
Cost of Equity Capital (Equally Weighted)						
Personal Lines	22.5%	22.3%	22.5%	25.3%	22.1%	23.1%
Commercial Lines	18.2%	20.3%	18.6%	21.2%	19.0%	19.5%
F-Test: $r_{Personal} = r_{Commercial}$	1.05	0.90	0.79	0.87		2.57
Cost of Equity Capital (Market Value Weighted)						
Personal Lines	12.3%	16.5%	20.1%	23.0%	18.0%	16.3%
Commercial Lines	15.9%	18.9%	20.3%	21.9%	19.2%	18.8%
F-Test: $r_{Personal} = r_{Commercial}$	2.95 *	0.96	0.00	0.10		3.75 *

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 11

Full Information CAPM Beta Estimates: Auto vs. Worker's Compenstion vs. All Other Property-Liability Lines of Insurance

Table displays full information CAPM beta estimates by-line of property-liability insurance. Automobile insurance includes personal automobile liability, commercial automobile liability, and automobile physical damage insurance.The full-informaton beta comes from the following cross-sectional regression

$$\beta_i = \Sigma\, \beta full_j(W_{ij}) + \upsilon_j$$

where β_i is the equity beta estimated using equation (6) for firm i, $\beta full_j$ is the estimated full-information beta for industry (line of business) j, W_{ij} is the percent of firm i's net sales in industry (line of business) j. The regression is estimated using OLS and via weighted least squares so we can obtain market-capitalization weighted industry (line of business) full-information betas. The weight is equal to the market capitalization of firm I relative to the market capitalization of all NYSE, AMEX, and Nasdaq stocks. Any firm with an estimated beta greater than 5 or less than -5 is removed from the sample. The full-information regression was estimated separately for each calendar year and as a pool regression across all four years. The risk-free rate of interest used to estimate the cost of equity capital was the 30 day T-bill rate in December 2000, 5.88 percent. The long-run historical market risk premium as of December 2000 was 8.49 percent.

	1997	1998	1999	2000	Average	Panel Estimate
Beta (Equally Weighted)						
Automobile Insurance	1.119	1.180	0.568	0.817	0.921	0.906
	(0.250)	(0.263)	(0.249)	(0.250)		(0.127)
Worker's Compensation	0.543	0.826	1.095	0.986	0.862	0.872
	(0.596)	(0.585)	(0.444)	(0.499)		(0.265)
All Other P&L Lines of Insurance	0.863	0.840	0.815	0.713	0.808	0.808
	(0.180)	(0.175)	(0.162)	(0.171)		(0.086)
F-Test: $\beta_{Auto} = \beta_{Worker's\ comp} = \beta_{All\ others}$	0.470	0.130	0.530	0.140		0.17
Beta (Market Value Weighted)						
Automobile Insurance	0.655	0.691	0.441	0.731	0.630	0.636
	(0.114)	(0.098)	(0.153)	(0.204)		(0.066)
Worker's Compensation	0.716	0.865	0.860	0.953	0.849	0.882
	(0.497)	(0.454)	(0.546)	(0.883)		(0.282)
All Other P&L Lines of Insurance	0.962	0.909	0.954	1.139	0.991	0.9486
	(0.104)	(0.091)	(0.127)	(0.174)		(0.059)
F-Test: $\beta_{Auto} = \beta_{Worker's\ comp} = \beta_{All\ others}$	1.520	1.090	2.54 *	0.850		4.97 ***
Cost of Equity Capital (Equally Weighted)						
Automobile Insurance	15.4%	15.9%	10.7%	12.8%	13.7%	13.6%
Worker's Compensation	10.5%	12.9%	15.2%	14.2%	13.2%	13.3%
All Other P&L Lines of Insurance	13.2%	13.0%	12.8%	11.9%	12.7%	12.7%
F-Test: $r_{Auto} = r_{Worker's\ Comp}$	0.710	0.080	0.960	0.080		0.010
F-Test: $r_{Auto} = r_{All\ Others}$	0.550	0.250	0.540	0.090		0.320
F-Test: $r_{Worker's\ Comp} = r_{Worker's\ Comp}$	0.240	0.000	0.330	0.250		0.050
Cost of Equity Capital (Market Value Weighted)						
Automobile Insurance	11.4%	11.7%	9.6%	12.1%	11.2%	11.3%
Worker's Compensation	12.0%	13.2%	13.2%	14.0%	13.1%	13.4%
All Other P&L Lines of Insurance	14.0%	13.6%	14.0%	15.5%	14.3%	13.9%
F-Test: $r_{Auto} = r_{Worker's\ Comp}$	0.010	0.140	0.530	0.060		0.700
F-Test: $r_{Auto} = r_{All\ Others}$	3.03 *	2.080	4.87 **	1.620		9.45 ***
F-Test: $r_{Worker's\ Comp} = r_{Worker's\ Comp}$	0.200	0.010	0.020	0.040		0.050

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.

Table 12

Full Information Fama-French 3-Factor Estimates with Sum Beta Adjustment: Auto vs. Workers' Compensation vs. All Other P&L Lines

Table displays full information beta estimates for the Fama-French 3 Factor Model by-line of property-liability insurance. Automobile insurance includes personal automobile liability commercial automobile liability, and automobile physical damage. The full-information beta comes from the following cross-sectional regression:

$$\beta_i = \Sigma \beta full_j (W_{ij}) + \upsilon_j$$

where β_i is either the excess market coefficient, the SMB coefficient, or the HML coefficient estimated using equation (8) for firm i, $\beta full_j$ is the estimated full-information coefficient estimate for industry (line of business) j, W_{ij} is the percent of firm i's net sales in industry (line of business) j. The regression is estimated via seemingly unrelated regressions both equally weighted and via weighted least squares (market weighted). The latter is used so we can obtain market-capitalization weighted industry full-information betas. The weight is equal to the market capitalization of firm i relative to the total capitalization of all NYSE, AMEX, and Nasdaq stocks. Any firm with an estimated factor coefficient greater than 5 or less than -5 is deleted from the sample. The full-information regression was estimated separately for each calendar year and as a pooled regression across all four years. The risk-free rate of ineterest used to estimate the cost of equity capital was the 30 day T-bill rate in December 2000, 5.88 percent. The long-run historical premium for the excess market return, the SMB factor, and the HML factor as of December 2000 were 8.49 percent, 2.21 percent, and 4.63 percent, respectively.

	1997	1998	1999	2000	Average	Panel Estimate
Market Value Weighted Results						
Beta Factor						
Automobile Insurance	0.795	1.016	1.023	1.284	1.029	0.971
	(0.112)	(0.105)	(0.156)	(0.197)		(0.066)
Worker's Compensation	0.906	0.917	0.815	0.576	0.804	0.867
	(0.493)	(0.485)	(0.557)	(0.853)		(0.283)
All Other P&L Lines of Insurance	1.164	1.171	1.263	1.484	1.271	1.228
	(0.103)	(0.097)	(0.129)	(0.168)		(0.059)
Small - Big Capitalization Factor						
Automobile Insurance	-0.470	-0.465	0.129	-0.258	-0.266	-0.438
	(0.168)	(0.158)	(0.176)	(0.233)		(0.089)
Worker's Compensation	-0.610	0.552	0.479	0.495	0.229	0.070
	(0.735)	(0.731)	(0.630)	(1.009)		(0.379)
All Other P&L Lines of Insurance	-0.360	-0.170	0.053	-0.116	-0.148	-0.143
	(0.153)	(0.146)	(0.146)	(0.199)		(0.079)
High - Low Book/Market Factor						
Automobile Insurance	0.135	0.727	0.146	1.447	0.614	0.687
	(0.179)	(0.210)	(0.233)	(0.335)		(0.115)
Worker's Compensation	0.154	0.758	0.146	-0.055	0.251	0.155
	(0.782)	(0.971)	(0.834)	(1.450)		(0.494)
All Other P&L Lines of Insurance	0.277	0.673	0.898	1.030	0.720	0.712
	(0.163)	(0.194)	(0.194)	(0.286)		(0.103)
F-Test: $\beta_{Auto} = \beta_{Worker's\ Comp} = \beta_{All\ Others}$	2.26	0.50	0.63	0.53		3.29 **
F-Test: $s_{Auto} = s_{Woorker's\ Comp} = s_{All\ Oothers}$	0.11	1.55	1.15	0.34		3.04 **
F-Test: $h_{Auto} = h_{Worker's\ Comp} = h_{All\ Others}$	0.13	0.01	1.44	0.83		0.55
Cost of Equity Capital (Equally Weighted)						
Automobile Insurance	22.9%	23.3%	19.0%	24.6%	22.4%	22.3%
Worker's Compensation	20.5%	20.0%	18.2%	20.1%	19.7%	19.6%
All Other P&L Lines of Insurance	17.3%	20.1%	20.4%	21.8%	19.9%	19.8%
F-Test: $r_{Auto} = r_{Worker's\ Comp}$	0.08	0.06	0.01	0.33		0.44
F-Test: $r_{Auto} = r_{All\ Other\ P\text{-}L\ Lines}$	1.68	0.20	0.09	0.38		1.24
F-Test: $r_{AWorkers'\ Comp} = r_{All\ Other\ P\text{-}L\ Lines}$	0.16	0.00	0.11	0.05		0.00
Cost of Equity Capital (Market Value Weighted)						
Automobile Insurance	12.2%	16.8%	15.5%	22.9%	16.9%	16.3%
Worker's Compensation	12.9%	18.4%	14.5%	11.6%	14.4%	14.1%
All Other P&L Lines of Insurance	16.2%	18.6%	20.9%	23.0%	19.7%	19.3%
F-Test: $r_{Auto} = r_{Worker's\ Comp}$	0.01	0.03	0.55	0.93		0.27
F-Test: $r_{Auto} = r_{All\ Other\ P\text{-}L\ Lines}$	2.75 *	0.39	0.06	0.00		4.01 **
F-Test: $r_{AWorkers'\ Comp} = r_{All\ Other\ P\text{-}L\ Lines}$	0.19	0.00	0.66	0.84		1.35

- ***, **, * significant at the 1, 5, or 10 percent level, respectively. Standard errors in parantheses.