A REPORT ON THE CAS COTOR RISK PREMIUM PROJECT

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The Risk Premium Project (RPP) represented the most extensive, thorough and up-to-date analysis of the theory and empirics of risk assessment for property-casualty insurance through 2000. The Project began as a response by industry and academic researchers[1] to a request for proposals issued by the Committee on the Theory of Risk (COTOR) of the Casualty Actuarial Society (CAS) due April 1, 1999. At the time the discounting of loss reserves was an important topic of debate among casualty actuaries and COTOR was interested in providing the members of the CAS with a review of the seemingly disparate academic and actuarial literature with the express hope of revealing appropriate discount rates for liabilities. The members of RPP proposed to address the topic using a three phased approach:

Phase I:	Provide a compilation of the most relevant academic and actuarial literature on risk assessment for the prior twenty years, approximately 1980-2000.
Phase II:	Discuss the equilibrium pricing for insurance risk in light of the Phase I literature.
Phase III:	Propose empirical projects to quantify some of the Phase II theoretical conclusions.

COTOR accepted the RPP proposal on August 13, 1999 and the researchers presented their final report on Phases I and II to COTOR on June 30, 2000.[2]

Phase I produced an annotated bibliography of 138 items consisting of 14 referenced books and 124 articles and papers from 37 financial and actuarial publications, including the *Proceedings of the Casualty Actuarial Society*, *Journal of Finance*, *Journal of Portfolio Management*, the *ASTIN Bulletin*, and National Bureau of Economic Research working papers. The bibliography is searchable by author, title, and keyword online at the CAS site above. The articles and papers are separated into themes that cover general finance, asset pricing, insurance risk, surplus allocation, the history of applications in finance and insurance and some miscellaneous topics.

The abstract of Phase II report is as follows:

This report summarizes the authors' review of the actuarial and finance literature on the subject of risk adjustments for discounting liabilities in property-liability insurance. The authors find that the actuarial and financial views of risk priced in the market are converging: systematic or non-diversifiable risk still plays a central role in equilibrium pricing, but non-systematic costs arising from market frictions such as taxes and financial risk management also contribute to market valuations. Recent advances in risk assessment and capital allocation techniques are noted. Several empirical follow-up projects are identified.

Among the specific conclusions the researchers reached included:

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1 There were four members of the RPP. The academic researchers included J. David Cummins and Richard D. Phillips. The industry researchers were Robert P. Butsic from Fireman's Fund and Richard A. Derrig who, at the time of the project, was with the Automobile Insurers Bureau of Massachusetts. Both industry members have recently retired while the academic members remain with their universities.

2 The report is available on the CAS website at www.casact.org/cotor/index.cfm?fa=rpp. Alternatively you search the CAS website using the key words Risk Premium Project.

(1) Although actuaries have long argued that non-systematic (non-market) risk plays a role in insurance pricing, financial economists have recently developed various theories that provide sound justification for this conclusion.

(2) Systematic risk plays a role in valuing liabilities either because the loss cash flows are contemporaneously correlated with market-wide returns or because unexpected changes in the interest rate used to discount long-term liabilities is correlated across all future cash flows in the economy. This latter effect is expected to be a more important factor for longer duration insurance liabilities.[3]

(3) Returns to financial assets cannot be adequately explained by the Capital Asset Pricing Model (CAPM) beta. Additional factors have been identified which significantly enhance the explanatory power of the models in general. Unfortunately, no such research focuses on insurance company returns.

(4) Equity capital can be allocated in a theoretically consistent way. Unfortunately no such research focusing on actual insurance companies exists.

(5) The issue of insurance default should be recognized in pricing.[4]

The Phase II report concluded with four specific suggestions for a follow-up Phase III empirical research that were focused on two broad areas of inquiry. The proposed areas of inquiry included studies to investigate the relevance of the multi-factor asset pricing models for the property-casualty insurance industry and to empirically investigate the role of capital allocation in insurance pricing given the recent theoretical advances in the literature. The projects were recommended based upon the observations in the Report that recently developed methods such as the Fame-French 3-factor extension of CAPM and the Myers-Read allocation of capital formulas allowed for new empirical estimates of cost and allocation of capital, both lacking for the property-casualty industry as a whole.

Ultimately, two of the four proposed projects were selected to be funded: one on cost of equity capital for insurers by-line of insurance and one on allocation of capital for insurers.[5] The result of the cost of capital study is a peer-reviewed paper that appeared in the *Journal of Risk and Insurance* (Cummins and Phillips, 2005). The paper was recently awarded the CAS prize for the best paper of interest to the CAS members in the 2005 volume of the *Journal of Risk and Insurance*. A session on the paper will be scheduled for the joint CAS/ASTIN meetings in June 2007 in Orlando, FL. The second Phase III study has resulted in a working paper (Cummins, Lin, and Phillips, 2006). Both papers are available on the same CAS/RPP website as the Phase I and II report. The principal results of those two studies are discussed next.

Cost of Capital

The study estimates CAPM and Fama-French cost of capital estimates for a sample of 117 companies writing property-casualty insurance over the sample period 1997-2000. Cost of capital estimates are estimated for each year of the sample period based on 60 monthly observations. The Fama-French model augments the CAPM market systematic risk factor with two additional factors, for firm size and financial distress, respectively. The size factor is based on the firm's market capitalization (number of shares multiplied by share price) and the financial distress factor is represented by the ratio of the book value of equity to the market value of equity.[6] In addition, the cost of

[3] As an example of the latter effect, the Phase II report cites research that shows supposedly "riskless" Treasury bonds have positive betas: 0.14 for intermediate maturity bonds and 0.42 for long-term maturities bonds (see Cornell, 1999).

[4] Insurer default is generally recognized as a pay-as-you-go system through guaranty funds.

[5] The two studies were jointly funded by the Casualty Actuarial Society and the Insurance Research Council.

[6] The Fama-French cost of capital is obtained by adding the risk-free rate, usually the 30-day Treasury bill rate, to the market systematic risk beta multiplied by the market risk premium for systematic risk plus the size beta multiplied by the market risk premium for size plus the financial distress beta multiplied by the market risk premium for financial distress.

capital is estimated specifically for the property-casualty, automobile, and workers' compensation insurance lines of business using both the full information industry and sum beta methodologies. These methods are fully explained in Cummins and Phillips (2005).[7] The cost of capital estimates are presented in several tables in the article. The results of the study demonstrate the statistical inadequacy of the single factor CAPM in estimating the cost of capital for property-casualty insurers. That is, the study demonstrates the importance of including the Fama-French adjustments for size and financial distress when estimating the cost of capital for property-casualty insurers.[8] In particular, the CAPM tends to significantly under-estimate the cost of capital for firms in this industry.

Although there is considerable empirical evidence supporting the use of the financial distress factor in asset pricing, researchers have yet to agree on the rationale for the presence of this effect. The financial distress effect is also often called the value effect because the ratio of book-to-market equity is often used to identify so-called "value" stocks. Theoretically, the literature on the value effect seems to have split into two camps: (1) The "rationalist" camp, which argues that the value factor is a rational pricing factor consistent with Merton's inter-temporal capital asset pricing model (ICAPM) or Ross' arbitrage pricing theory (APT). (2) The "behavioralist" camp, which argues that the value factor may be a behavioral effect reflecting irrational investor behavior (e.g., Lakonishok, Schleifer and Vishny, JF 1994).

Data

The study utilized an extensive database on companies writing property-casualty insurance, including 75 companies designated as property-casualty insurers and 42 additional multi-line companies. The companies in the sample wrote about one-third of total property-casualty insurance premiums in 2000 (Table 1).[9] Financial returns covering the period 1997-2000 were analyzed using data from 1992-2000.

Methodologies

The analyses reported in the Cummins-Phillips JRI paper include:

(1) Standard CAPM 60 month equity betas and costs of capital (Table 2).
(2) Standard CAPM 60 month equity betas and costs of capital with the sum beta adjustment for infrequent trading bias (Table 2).
(3) Fama-French three factor model (FF3F) risk premia and costs of capital based on factors representing market systematic risk, firm size, and the ratio of book equity to market equity capital (Tables 3 and 9).
(4) Full Information Industry Beta (FIIB) costs of capital for the property-casualty insurance line of business. The FIIB method decomposes equity betas arising from multi-industry traded stock returns into industry-specific betas. This method is applied to the property-casualty (P&C) industry as well as to estimate cost of capital for lines of insurance such as workers' compensation and automobile insurance (Tables 8 and 9).

Principal Findings

(1) Sum betas are larger than raw betas

As expected, sum beta estimates are consistently larger than ordinary beta coefficients. For the sample as a whole the raw beta averaged 0.677 versus the sum beta 0.836, or a 23 percent larger equity beta. The reason for the increase in averages is the dominance of smaller insurers with relatively infrequent trading (which sum beta corrects) in the 117 company sample (Table 2).

(2) The Fama-French market systematic risk beta is about 1.0 for P&C Insurers

The overall market beta for P&C insurers, with (1.04) or without (0.98) the sum beta correction, is about the market average of 1.0. This result indicates that the low raw beta average (0.67) arises primarily from the single simple factor regression omitted variables problem identified 10 years earlier by financial researchers,[10] size and financial distress (Table 3).

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[7] The current status of the asset pricing literature is reviewed in Fama and French (2004).

[8] Additional specifications of multifactor models specific to insurer returns are discussed in the Recent Developments section here.

[9] Designated P&C insurers by Compust at a vendor of stock market data.

[10] The fact that significant explanatory variables omitted in a structural regression can cause distorted results is well known in statistics (see, for example, Maddala (1992), pp. 161-164). .

(3) The FIIB market systematic risk beta for auto insurance averages 0.92 based on unweighted regressions but averages 0.64 when the regressions are weighted by market values.

Based on equally weighted regressions, the market systematic risk betas are about the same for automobile insurance (0.92) and workers' compensation (0.86). However, based on market value weighted regressions, the market systematic risk beta for auto insurance (0.64) is significantly different from the beta for workers' compensation (0.882) (see Table 8). Because the market value weighted regressions give greater weight to larger insurers, the results provide clear evidence that systematic risk betas vary by firm size.

(4) The FIIB Fama-French market systematic risk beta with the sum beta correction for auto insurance is about 1.0 based on market value weighted regressions.

Applying all methodologies to estimate the underlying market equity beta yields a market weighted average of 1.031 and a panel estimate of 0.965, neither significantly different from 1.0, for automobile insurance. The contrast with conclusion (3) indicates a strong case for using the sum beta adjustment (Table 9).

(5) The size factor in the FIIB Fama-French estimation is significantly different from zero at about 1.6.

The FIIB Fama-French three-factor estimates in Table 9 shows size betas for auto insurance of 1.686. Applying a size beta of 1.6 to the long-term excess market premium for size of 2.35 percent yields an average size adjustment of about 3.8 percent. Ibbotson (2006, p. 31) graphically displays the difference in the realized return distributions between large company stocks and small company stocks in general. Small stocks have larger mean returns and a larger variance of returns. Of course, the notion that a (non-systematic) small stock premium exists has been known since the at least the 1980s. The Cummins-Phillips extends that result specifically to the insurance industry as a whole and to property casualty insurers in particular.

(6) The financial distress betas for property-casualty insurance are substantially greater than for firms on average from other industries.

Based on market value weighted regressions, Table 7 shows financial distress betas of 0.917 for personal lines and 0.992 for commercial lines. Based on the financial distress risk premium for 2000 (3.85%), the financial distress factor adds more than 3% to the cost of capital. Based on estimates for other industries, financial distress or, conversely, proxies of the quality of insurer risk management affects returns for insurers much more significantly than for most other firms in the economy.

Some Relevant Developments since 2000

There have been some important contributions to the insurance finance literature since the compilation of the RPP bibliography. The primary thrust of the post-RPP financial literature has been to move away from the standard version of the capital asset pricing model to reflect the importance for insurance pricing of non-hedgeable insurance risk, insolvency risk, capital allocation, and negatively skewed return distributions.[11] These developments provide additional theoretical support for the importance of recognizing factors other than the CAPM market systematic risk factor when estimating the cost of capital for insurers. This section summarizes the results of the most important papers, without attempting an exhaustive survey. Because the post-RPP papers are extensions of the model presented in Froot and Stein (1998), that paper is also discussed.

Froot and Stein (1998) develop an important theoretical model based on the hypothesis that financial institutions care about risk management because holding capital is costly and because they face convex costs of raising external capital. Holding capital is costly due to various frictional costs such as corporate income taxation, agency costs, and regulatory costs. Raising new external capital is costly because of informational asymmetries between firms and capital market and for other reasons (Myers and Majluf 1984, Froot, et al. 1993). Financial institutions also are hypothesized to invest in information intensive, illiquid assets which cannot be fully hedged in financial markets.[12] Under these conditions, Froot and Stein (1998) show that the prices of illiquid intermediated risk products are generated by a two-factor asset pricing model, consisting of the standard market systematic risk factor and a factor

[11] See Kozik and Larson (2001) for a discussion of pricing skewness of returns in general and in the context of insurers and multifactor CAPM models.

[12] In the case of property-liability insurers, the illiquid, unhedgeable projects are insurance liabilities created by issuing various types of insurance policies. Hedgeability here refers to the ability to costlessly eliminate risk by trading in derivatives and other financial instruments. Of course, insurance risk can be hedged through reinsurance and alternative risk transfer products, but such hedging is costly and generally not complete.

reflecting the covariability of the risk product's returns with the institution's pre-existing portfolio of non-tradeable risks. The price of the latter covariability term depends upon the institution's effective risk aversion, which is a function of the convexity of the cost function for external capital as well as the capital structure of the institution. Specifically, the price is inversely related to the amount of capital held by the firm because risk aversion declines as capital increases. Thus, the principal predictions are that the price of an intermediated risk will be positively related to its covariability with the other risks in the institution's portfolio and will be inversely related to the institution's capitalization.

An extension of the Froot and Stein (1998) model is presented in Froot (2005), who explicitly introduces a model applicable to insurers and reinsurers. Froot observes that insurance companies are likely to be especially sensitive to insuring risks that adversely affect solvency. Because insurance customers are only imperfectly protected by government guarantees, they are likely to be more sensitive to firm solvency risk than insured bank depositors. Also, because contract performance risk is likely to be high relative to wealth for insurance policyholders, such customers also are likely to be "more risk averse than capital providers, discounting future claims more heavily on the basis of even relatively small probabilities of failure (Froot 2005, p. 3)." Insurers are also likely to be especially sensitive to the costs of holding risks because their project return distributions tend to be characterized by negative skewness due to positively skewed insurance claim distributions. Thus, Froot (2005) generalizes the Froot-Stein model to incorporate policyholder insolvency aversion and negatively skewed return distributions.

The result of Froot's (2005) modeling is the development of a three-factor pricing model for non-tradeable, negatively skewed insurance risks. In addition to the market systematic risk factor, the model includes a factor for the covariability of a given risk with the firm's other non-traded risks (the "firm-wide" risk factor) as well as a factor that prices the asymmetry of the insurer's return distribution. The predictions of the model are similar to those of Froot-Stein, except that Froot (2005) predicts even stronger departures from the prices predicted by perfect market financial models such as the single factor CAPM, reflecting policyholder risk aversion and asymmetrical returns.

Neither the Froot-Stein (1998) nor the Froot (2005) model incorporates the explicit allocation of capital by line of business. An important (primarily theoretical) paper that does address the role of capital allocation in insurance pricing is Zanjani (2002). Zanjani's model explicitly incorporates elements from both the Froot-Stein (1998) and Froot (2005) models as well as from Myers-Read (2001) and other capital allocation papers. Zanjani's model rests on three key assumptions: (1) Loss outcomes are risky, so insurers face significant insolvency risk, (2) it is costly for firms to hold capital, and (3) the risk of insolvency matters to consumers. The existence of costly capital as well as consumer demand for solvency leads to insurer risk aversion and provides the rationale for risk management. Insurers thus "will pay to avoid risk and charge to bear it, with the risk charge in a given market segment being determined by that segment's associated marginal capital requirement. Price differences across market segments are therefore explained by differences in marginal capital requirements (Zanjani 2002, p. 284)." As in Froot and Stein (1998) and Froot (2005), unsystematic risk matters in the pricing of intermediated risk products; and marginal capital requirements play an important role in explaining cross-sectional price differences. In Zanjani's model, the principal pricing factors are the usual capital market systematic risk term, a factor representing the frictional costs of holding capital, and the marginal cost of the capital required to maintain constant financial quality (insolvency risk).

Risk Premium Project

The theoretical developments above paralleled a flurry of papers that attempted to make progress on the empirical estimation of the systematic or market factor risk premium used in all the extended models. Known as the "risk premium puzzle" since the mid-1980s,[13] many researchers promoted market risk premium estimates based on varieties of data series, both US and international, methods of interpreting the data, and even surveys of "experts" such as finance professors. Derrig and Orr (2004) surveyed a representative sample of such efforts and found a wide disparity of prospective market risk premiums in the studies ranging from -0.9% to 8.5%. A fair amount of the numerical disparity was based on a lack of a common definition for "*the market risk premium*." Rather, the risk

[13] The risk premium puzzle is simply that realized market risk premiums excess of a risk free rate for some recent time periods would relate to risk aversion coefficients in standard models that exceed all prior (reasonable) estimates. Of course, those simple risk aversion/risk premium models could be misspecified just as the simple CAPM is misspecified with significant omitted variables.

premiums in the studies varied by the use of real or nominal interest rates, arithmetic or geometric averaging, short, intermediate and long horizons, short or long run averages, and conditional or unconditional estimates. Put on a common definitional basis of short horizon, long run, arithmetic, and unconditional risk premium, the appropriate basis for valuation of quarterly flows in insurance pricing, the range of risk premium estimates narrowed considerably to 5.0% to 9.0%. The risk premium puzzle is now incorporated into Part 8, Investments and Financial Analysis of the CAS Fellowship Examinations.

Allocation of Capital

The paper by Cummins, Lin, and Phillips (2006) provides an empirical test of the theories developed by Froot and Stein (1998), Froot (2005), and Zanjani (2002). The overall prediction of these papers is that prices of illiquid, imperfectly hedgeable intermediated risk products should depend upon firm capital structure, the covariability of the risks with the firm's other projects, their marginal effects on the firm's insolvency risk, and negative asymmetries of return distributions. In particular, prices should be higher for lines of insurance with higher covariability with the insurer's overall insurance portfolio and for lines that have a greater marginal effect on insurer insolvency risk. Cummins, Lin, and Phillips (2006) provide empirical tests of these theoretical predictions using data from the U.S. property-casualty insurance industry. The strategy in the paper is to estimate the price of insurance for a sample of property-casualty insurers and then to regress insurance price on variables representing firm solvency risk, capital allocations by line, and other firm characteristics.

The empirical tests in Cummins-Lin-Phillips are based on two pooled cross-section, time-series samples of U.S. property-casualty insurers over the sample period 1997-2004. The first sample consists of the maximum number of insurers with usable data that report to the National Association of Insurance Commissioners (NAIC). The second sample consists of the subset of insurance firms that have traded equity capital.

To measure the price of insurance, Cummins-Lin-Phillips utilize the *economic premium ratio (EPR)* suggested by Winter (1994). The EPR, the ratio of the premium revenues net of expenses and policyholder dividends for a given insurer and line of insurance to the estimated present value of losses for the line, provides a measure of the insurer's return for underwriting a line of insurance.[14] Theory predicts that the EPR will be related cross-sectionally to insurer capital structure, the covariability among lines of insurance and between insurance lines and assets, and the amount of capital allocated to each line of business.

To estimate by line capital allocations, Cummins-Lin-Phillips utilize the methodology developed by Myers and Read (2001). Myers-Read allocate capital marginally by taking the derivative of the firm's insolvency put option with respect to changes in loss liabilities for each project or line of business. The methodology provides a unique allocation of 100% of the firm's capital. Although the Myers-Read model is not dependent upon specific distributional assumptions for the returns on the firm's assets and liabilities, distributional assumptions are required to implement the methodology empirically. Cummins, Lin, and Phillips (2006) assume that assets and liabilities are jointly lognormally distributed so that capital allocation is based on the Black-Scholes exchange option model (Margrabe 1978).

Although the Myers-Read model clearly has normative implications for insurance management and regulation, Cummins-Lin-Phillips hypothesize that it also has positive implications for insurance markets. That is, an implicit underlying hypothesis in the paper is that cross-sectional differences in insurance prices can be partially explained by Myers-Read capital allocations. In order for this hypothesis to be correct, it is not necessary that insurance companies actually allocate capital according to the Myers-Read model. It is only necessary that, through the operation of insurance markets, risks are priced in such a way that prices reflect the marginal burden that specific risks place on the insolvency risk of insurers. This requires only that markets are sufficiently rational that insurers are able to assess the riskiness of policies that are being priced and that their price quotes reflect these insolvency risk assessments.

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[14] The economic premium ratio is a widely accepted measure of aggregate insurance prices, which has been used extensively in the prior literature (e.g., Winter 1994, Gron 1994, Cummins and Danzon 1997). The EPR is more meaningful than the traditional unit price of insurance, defined as the premium divided by the undiscounted value of losses (e.g., Pauly, et al. 1986). Because premiums will reflect discounting of losses in a competitive market, the EPR improves upon the unit price by also discounting the losses in the denominator of the ratio.

The methodology used by Cummins-Lin-Phillips provides an especially strong test of theories of pricing intermediated risks. In the absence of data on the prices of individual insurance policies, they are required to base the price measure on aggregate data by line of insurance. Moreover, individual firm internal capital allocations are also unavailable. Consequently, the paper constitutes an exercise in applying financial theory to publicly available data to determine whether theory can explain cross-sectional differences in prices observed in the sample. Because it is possible that the predicted relationships could be somewhat obscured due to aggregation, support for the predictions in the empirical tests constitutes strong evidence that the theories explain the pricing of intermediated risks.

The Cummins-Lin-Phillips tests support the theoretical predictions. The price of insurance as measured by the EPR is inversely related to insurer insolvency risk, consistent with prior research (Phillips, et al. 1998). Moreover, prices are directly related to the amount of capital allocated to lines of insurance by the Myers-Read model and thus are also directly related to the covariability of losses across lines of insurance. Thus, the results support the predictions of Froot and Stein (1998) and the capital allocation literature (Myers and Read 2001, Zanjani 2002). The tests provide somewhat weaker evidence that prices reflect negative asymmetries of return distributions (Froot 2005).

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