5. Research Approach

5.1 Overview

For each of the three insurance products, we selected 20 representative property and casualty insurance company groups. (It is common within the insurance industry for an insurer to operate its business through multiple legal entities under common ownership and management, described informally as a "group".) Because some company groups offer multiple products, the same company group was sometimes included in our analysis for more than one insurance product. However, each product within a company group was treated separately for analysis purposes (in other words, as if each company group's insurance product was sold by a stand-alone company), without consideration of cross-product correlation or risk diversification benefits. Late in the project we concluded that data problems with two of the Medical Professional Liability company groups were too great to use them in the study; the results for this product are therefore based on only eighteen company groups.

Using the regulatory reports for each sample company group as a starting point, we performed two major steps to restate the financial data.

1. *First, we adjusted the regulatory financial data to a pro forma U.S. GAAP basis.* Since regulatory accounting does not permit deferral of policy acquisition expenses, this entailed estimating a deferred policy acquisition cost asset (DPAC) for each company, product, and statement date. In addition, we adjusted the claim and defense cost liabilities in the regulatory financial data to a consistent undiscounted basis for those few companies that reported their regulatory claim and defense cost liabilities on a discounted basis. While discounting of these liabilities is permitted under U.S. GAAP, the prevailing practice is to report claim and defense cost liabilities on an undiscounted basis. Since we intended to introduce a discount for the time value of money in the estimates of fair value, it was necessary to have undiscounted liabilities as our starting point.
2. *Second, we adjusted the pro forma U.S. GAAP financial statements to reflect claim and defense cost liabilities presented on a fair value basis.* This entailed calculating a discount for the time value of money and a market risk margin for each company group, product, and statement date. We calculated the market risk margins using two alternative methodologies, such that we ended up with two alternative fair value presentations.

While fair value does not require that elemental components (i.e., expected cash flows, time value of money, market risk margin) be calculated separately, it does appear that all three elements must be at least theoretically present. We chose to build our estimates of fair value by component so that we could analyze the progression of the three elements separately.

Finally, we compared the results of step one to the results of step two to gauge the likely impact of fair value on the company groups' reported financial results. Each of these steps is described more fully below, with additional details covered in the Appendix.

5.2 Published Regulatory Financial Data

For each of the three insurance products (Personal Auto Liability, Workers Compensation, and Medical Professional Liability), we selected a final sample of 20 company groups (eighteen for Medical Professional Liability) and constructed a history of their regulatory financial statements for the 11-year study period, reflecting only the results for the specific product. The final list of companies selected for each product, as well as some of the considerations and data issues involved, can be found in Appendix 8.1.

To ensure we portrayed a fair sample of the property and casualty insurance industry for each product, we included company groups that ranged in size (based on their direct written premiums). The mix of company groups includes large national companies as well as mid-sized regional or single-state insurers. Over the time period evaluated, the cumulative market share for the company groups we selected is approximately 60% for Personal Auto Liability, 25% for Workers Compensation, and 50% for Medical Professional Liability.

Since part of our analysis focuses on the progression of financial statements over the 11-year period, it was important to ensure that those statements contain minimal discontinuities. In order to maintain reasonable consistency over the time period, each company group was reconstituted to include the same set of insurance company legal entities as it did at the end of 2002.

The financial data used to construct each company group's historical regulatory financial statements were drawn from a database of annual regulatory reports for each individual insurer legal entity. The principal schedule within the regulatory report from which the financial data were drawn is the Insurance Expense Exhibit ("the IEE"). The Insurance Expense Exhibit requires property and casualty insurers to allocate each element of their (pre-tax) income statement, as well as selected balance sheet items, to thirty-three (33) prescribed product lines, including the three that were the focus of our study.

For this project, we used data from Part 3 of the IEE to create historical regulatory income statements by line of business for each of the company groups in our final sample. Since Part 3 reflects direct business only, the revenue and expenses associated with assumed and ceded reinsurance transactions are excluded.

In a few cases we developed "work-arounds" that substituted more reasonable values for data in the IEE that we considered anomalous. Specific adjustments made to the data of individual company groups are described in Appendix 8.1.

Part 3 does not include an allocation of the company's investment income to product line. Even if it did, such an allocation would be of questionable value, given the assumptions that would be required. Rather than develop an allocation ourselves, we have included investment income by calculating the total return (with assets "marked to market", as they would be under fair value) on a hypothetical portfolio of risk-free assets equal to the nominal loss and defense cost liabilities. This is a reasonable proxy for the total (pre-tax) income from the insurance operations of the company, and is sufficient to analyze the effects of a change to fair value. It implicitly ignores the investment income on capital; essentially our income statement reflects only the results from "insurance operations".

Composite regulatory financial data for the 20 companies for each product are displayed in Exhibit 8.1.4 at the end of Section 8.

5.3 Adjustments to Convert Data to Current U.S. GAAP

The differing aims of regulatory financial reporting (referred to in the U.S. as statutory accounting principles, or "SAP") and generally accepted accounting principles (GAAP) necessitate differing treatment of certain items. The most significant difference is the treatment of policy acquisition costs. Under SAP these costs are charged to income when they are paid (i.e., at the time the policy is written), reflecting the goal of conservatism inherent in regulatory reporting. However, under current U.S. GAAP, the recognition of these expenses is matched to the related revenue, in this case the earned premiums on the associated policies. That is, under GAAP when a policy is written, a deferred policy acquisition cost (DPAC) asset is established in the amount of the related expenses. Then, as the premium is earned over the life of the policy, the DPAC asset is amortized into expenses.

To adjust the published regulatory financial statements to a *pro forma* GAAP basis, we created an estimated DPAC asset for each company group at each statement date based on the underwriting expense figures from the Insurance Expense Exhibit. Appendix 8.1 provides the details of this adjustment.

In addition to estimating DPAC assets for each company, we also adjusted the published regulatory data for identified instances in which the claim and defense cost liabilities were discounted for the time value of money. (As has been indicated, our goal was to achieve a consistent set of undiscounted liabilities as a starting point for our estimates of fair value.)

Two distinct types of discounting are present in the reported regulatory loss reserves. First, SAP allows all insurers to use a tabular discounting approach (that is, annuity claim reserves that combine life expectancy and the time value of money into a single tabular value for each attained age). Tabular discounting may be used on all individual claims involving life pension benefits. Claims involving life pension benefits are common in Workers Compensation; they are relatively rare in other lines, such as Auto No-Fault, as few states have adopted systems that provide such benefits. A second type of discounting is referred to as non-tabular (to distinguish it from tabular discounting). This type of discounting is sometimes permitted for a particular company and line of business by regulators on a discretionary basis. Typically a non-tabular discount is calculated on the entire inventory of claims; an aggregate expected settlement cash flow is generated and then discounted. In our sample of company groups, non-tabular discounts were reported at some point in their history by six Workers Compensation insurers, six Medical Professional Liability insurers, and one Personal Auto Liability insurer. For those insurers who reported non-tabular discounts, their impacts ranged from 1% to 32% of the reported claim and defense cost liabilities.

GAAP practices relating to discounting also vary from insurer to insurer. Many insurers employ parallel discounting practices for GAAP and SAP. Others may discount their claim and defense cost liabilities in one context, but not the other; or they may employ different assumptions. Since tabular discounting is a long-standing practice within the industry (dating back to at least the 1950s), it is very common for tabular discounting practices to be parallel between GAAP and SAP; however it is less common for non-tabular discounting practices to be parallel between GAAP and SAP. As described more fully in Appendix 8.1,

our approach was to adjust the reported claim and defense cost liabilities only for the reported non-tabular discounts. This was largely a practical concession to the available data. However, we do not believe that the inclusion of tabular discounts materially affects our results or conclusions.

There are other differences between SAP and GAAP that are excluded from our analysis because they were not considered to be material. These items include:

- Claim and defense cost liabilities are recorded net of anticipated subrogation and salvage recoveries under GAAP, but not under SAP;
- Policyholder dividends that are planned but not formally declared are usually accrued as a liability under GAAP, but not SAP. SAP records policyholder dividends as a liability at the time that the dividends are declared;
- GAAP accruals for additional premiums under retrospectively rated policies and policies subject to audit are typically less conservative than they are under SAP.

Composite financial data for the 20 companies, adjusted to an estimated *pro forma* U.S. GAAP basis, for each product are displayed in Exhibit 8.1.5 at the end of Section 8.

5.4 Discounting for the Time Value of Money

Principles dictate that estimates of the fair value of policy claim and defense cost liabilities incorporate (a) the best estimate of the expected cash flows associated with these liabilities, (b) the time value of money, and (c) a margin reflecting the amount that marketplace participants would demand as compensation for *systematic* risk. While these elements need to be incorporated in any estimate of fair value, they need not be separately determined. For example, one can directly observe the market price of a particular publicly-traded stock and use that price as its fair value without separating the price into its component elements. (Having directly observed the prices, one could use an accepted pricing model drawn from financial economics to estimate the elements within the price; typically one would estimate two of the three elements and then infer the third as a residual. While this would not be needed to measure the fair value of the stock itself, it might yield important information about underlying market pricing assumptions that one could use in estimating the fair value of other assets or liabilities.)

For this research project, we have elected to estimate the fair value of policy claim and defense cost liabilities by building up the three component elements. Our choice of this approach does not imply that this is the only approach, nor is it necessarily the best approach. Its principal advantages are practicality and the ability to directly observe the interaction of the three component elements. This section discusses the development of the first two elements, the expected cash flows and the time value of money. The next section discusses the development of the market risk margin.

Our starting point was the *pro forma* GAAP claim and defense cost liabilities for each company group, product, and statement date. We assumed that those amounts represent the best estimate of the nominal ultimate liabilities as of each statement date. Calculation of the adjustment for the time value of money requires two major assumptions: the timing of the expected future cash flows and selection of appropriate interest rates. A discussion of the

considerations and issues associated with these assumptions, as well as our results, follows below. The technical details of the calculations are presented in Appendix 8.2.

The actuarial data necessary to calculate appropriate discounts for the time value of money (and to calculate the market risk margin, discussed subsequently) were drawn from Schedule P of each of the selected company group's annual regulatory reports. Unfortunately, the data are not available on a direct basis (that is, on a basis directly comparable to the IEE financial statement data that we developed). The bulk of the data in Schedule P are net, after application of all reinsurance. For the purposes of this project, we have elected to use the net data to develop the fair value adjustments, and then apply those adjustments to the direct claim and defense cost liabilities.

In essence, the use of the net data is tantamount to assuming that the patterns of the cash flows developed from the net data for each company group are (proportionately) the same as those that we would have developed on a direct basis, given the data. This assumption is not likely to be borne out in practice. Recoveries under non-proportional reinsurance are only made after the insurer has paid losses beyond its retained layer; to the extent that this type of insurance (which is very common) is present, the direct cash flows for a company are likely to be longer than the net cash flows. In addition, significant changes in reinsurance programs over time can create "noise" in the pattern of net claim payments that would not be present in the direct data. Notwithstanding these comments, we believe that the adjustments for time value of money that are derived from the net data are reasonable, and perhaps slightly conservative.

Development of Payment Pattern Assumptions to Project the Future Cash Flows

A generally accepted actuarial method for projecting the future cash flows associated with policy benefit liabilities is to derive an expected payment pattern applicable to a typical coverage year cohort of claims, by examination of historical claim emergence data. Typically the historical claim data are arrayed as a triangle with transactional data summarized by coverage year (in other words, all transactions associated with a claim are assigned to the year in which the coverage was provided and the insured events occurred) and by maturity, showing the actual payments made at successive maturities for each cohort. The historical patterns of payments are analyzed and adjustments are made for changes in conditions to produce a pattern that is believed to be appropriate for the future. Once derived, the expected payment pattern is then applied to the estimated unpaid policy liabilities by coverage year to obtain the projection of expected future cash flows.

The articulated fair value principles express a strong preference for market-based methods and assumptions over entity-specific methods and assumptions. Clearly, the basic actuarial method outlined above for projecting future policy liability cash flows could be considered to be a market method as FASB has defined it, as it is used routinely by property and casualty insurers in developing asking prices for the insurance policies that they wish to sell. However, within the broad method there are a variety of specific techniques for developing the payment pattern; different techniques will produce somewhat different patterns. It is unclear from the available guidance whether these different techniques represent nuances within a market-based method, or whether they represent entity-specific methods in need of

greater market resolution. We have assumed that the former is the case, and used a single selected technique to develop the payment patterns.

A related (and more critical) issue is whether the payment pattern assumption should be developed for the market as a whole using industry data, or whether each insurer should use its own data (supplemented by industry statistics where the insurer's data are not sufficiently credible) to calculate an entity-specific payment pattern assumption. As a review of the results will show, there are material variations in coverage year payment patterns between insurers. The causes for these variations fall into three categories: (1) differences in the nature of the company's customers; (2) differences in the coverage provided; and (3) difference in company operational procedures.

Different approaches to marketing, product distribution, and underwriting criteria contribute to differences in the makeup of each insurer's customer base. Since customers have differing claim propensities, their expected pattern of claim payments will vary. For example, larger claims typically take longer to settle, because they are often more problematic that smaller claims. Customers with a greater propensity for serious claims are, all other things being equal, therefore likely to have a slower pattern of expected claim payments. Similarly, since most insurance claims are adjudicated through state judicial and administrative systems with varying procedures, variation in the mix of customers by state can create significant variations in claim payment patterns.

In personal insurance such as Auto Liability, customer demographics can vary substantially from one insurer to the next. An example of this phenomenon might be the program sponsored by the AARP and underwritten by The Hartford, which targets retirees. Other companies target the wealthy, youthful operators, alumni of a particular university, owners of specific models of cars or members of a profession; other companies sell products through agents located in geographic areas that they perceive to be attractive.

In commercial insurance such as Workers Compensation and Medical Professional Liability, the variations in expected claim payment patterns between categories of customers can be even more pronounced, because of the variation in the businesses of the customers. A good example might be the variation between private practice physicians and hospitals, both of which purchase Medical Professional Liability insurance. Although they are combined under one product in the regulatory financial reports, their underlying exposure is quite different. Even within the physicians category, significant differences in exposure exist — for example, between dermatologists and orthopedic surgeons. In Workers Compensation, each industry has its own distinct hazard profile, generating different expectations as to the mix of injuries that will be generated.

In addition to differences in the underlying exposure of customers, the coverage provided can also vary. Even within relatively standardized contracts like Personal Auto, customers purchase different limits for their liability coverage. Very generally, the least affluent customers tend to purchase the minimum limits (e.g., $25,000) while the most affluent customers tend to purchase optional higher limits (e.g., $1,000,000). Since claim payments are truncated at the policy limit, payout patterns for the former tend to be much faster than the latter.

In commercial insurance there is even greater flexibility in coverage terms. Some customers purchase "first dollar" coverage; others purchase coverage over per-claim deductibles that are often as high as $25,000 and can be as high as $1,000,000. These deductibles tend to

eliminate coverage for smaller claims that would otherwise usually be paid relatively quickly. On larger claims the insurer's payments do not commence until the insured's deductible has been reached. Both of these factors tend to cause claim payment patterns to be longer on policies with deductibles. Differences in coverage limits and exclusions on certain types of claims will also have an influence on commercial insurance claim payment patterns.

Finally, the form of the coverage itself can vary. In Medical Professional Liability (as well as some other liability insurance products) coverage can be provided either on an "occurrence" basis or a "claims-made" basis. Simply stated, the former covers claims that occurred within the policy period, without regard to when they are reported; the latter covers claims that are reported during the policy period, without regard to when they occurred.

Given identical exposures and coverage, expected claim payout patterns will still vary between insurers, owing to different operating structures and claim handling procedures. Some insurers prefer to have their own staff of field claim adjusters and house counsel, while others make greater use of independent contractors. Companies will also differ in their approach to defending liability claims, protecting themselves against fraudulent claims, use of structured settlement approaches, use of medical case managers and return-to-work programs, and pursuit of subrogation recoveries. The companies believe that their approach will have a positive influence on the ultimate cost of the claims, as well as the timing of payment. Re-engineering of claim operations has been an ongoing activity within the property and casualty insurance industry, as companies seek to achieve a competitive advantage through lower claim, defense and adjusting costs.

Differences in company payment patterns that are caused by differences in customers or coverage terms could be addressed by being more careful in defining what constitutes a product and a market. The available industry data are not sufficiently refined in this regard; greater segmentation of the data by type of customer and coverage purchased would be required if market assumptions as to payment patterns are required. Differences in company payment patterns that are caused by operational differences are, of course, entity specific.

Unfortunately while it is possible to observe differences in claim payment patterns between insurers, it is much more difficult to separate the observed differences into their root causes (customer and coverage differences versus operating differences). A more pragmatic solution to this issue may therefore be to permit the use of entity-specific assumptions as to payment patterns. In our experience, this is the approach that market participants use when pricing (limited) loss portfolio reinsurance transfers, and when performing appraisals of companies or blocks of business for sale or purchase.

For this project, we calculated an (entity-specific) payment pattern assumption for each company group at each statement date, based on information that would have been available to the company at the time. Our approach is generally consistent with practices commonly found in the industry — in both the internal practices of companies, and the practices of reinsurers who price loss reserve portfolio reinsurance products. We first developed "benchmark" payment patterns at each statement date, using the composite data of the 20 selected companies. As a proxy for judgment, the payment pattern for each company group was determined by credibility-weighting the pattern indicated by its own data with the composite pattern. (Generally, the credibility of the company group data was high.) Finally, we applied each company group's payment pattern assumption to its estimate of unpaid

claim and defense cost liabilities to obtain a projection of their expected future claim and defense cost cash flows.

To construct the payment patterns we used data from Part 3 of each company group's Schedule P. Since Schedule P provides data extending only to the tenth maturity, we assumed that all remaining payments occur in the eleventh year.

Exhibit 5.4.1 displays the average-time-of-payment (measured in years from contract inception) implicit in the coverage year payment pattern derived for each company at year-end 2002. The dispersion among companies is evident. Variations within each of the product lines reflect the factors alluded to earlier. Even the Personal Auto Liability product, the fastest paying of the three, exhibits variation. (The auto outlier is a single-state writer, operating in a state that is considered problematic from a claim standpoint.) Variations in Medical Professional Liability are most pronounced, particularly because of differences in the form of coverage sold by the various insurers.

Exhibit 5.4.1

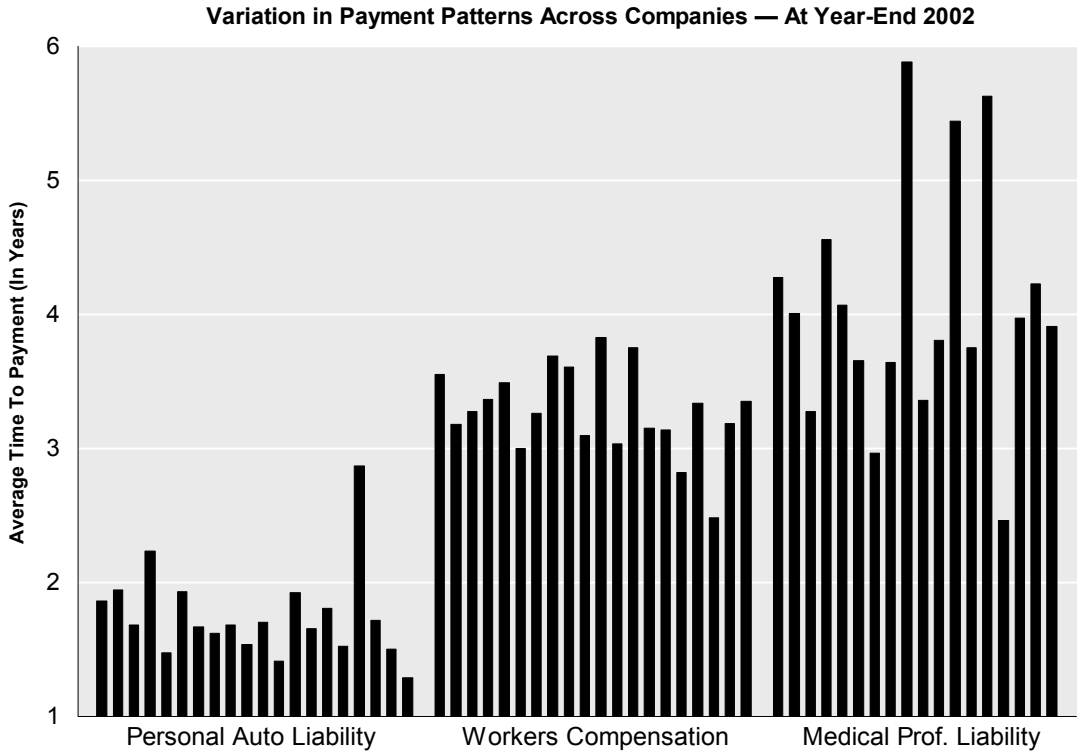


Exhibit 5.4.2 displays the same average-time-of-payment data by company group, and also over time. The composite result is also displayed, so that any overall trends over time can be discerned. Since the mix of customers, coverage sold and operations of a particular company can be expected to change only gradually over time, we would not expect an abrupt shift in this statistic. Evidence to the contrary would suggest that the derived payment pattern assumptions are not reliable.

- For Personal Auto Liability, there is a slight overall trend towards a shorter average-time-to-payment, reflecting industry-wide efforts to settle claims more quickly. While company variations are evident, there are very few unusual values over the 12-year period.

- For Workers Compensation, the overall average-time-to payment is stable across the period. One company exhibited an abrupt shift to an unusually short average-time-to-payment in 1997 (possibly due to a change in its reinsurance program).
- For Medical Professional Liability, there is a significant trend towards a shorter average-time-to-payment. This result is largely driven by the indicated amount of payments beyond 10 years. In the experience reports for the older years there are significant reported liabilities remaining at the end of the tenth maturity; in the more recent reports the relative amounts of unpaid claim and defense cost liabilities remaining at the end of the tenth maturity are lower. When we control for this effect (by substituting a fixed assumption as to the amount of payments beyond 10 years) the trend is substantially reduced — to a level commensurate with that observed in Personal Auto Liability.

One possible explanation for the trend would be a shift in the mix of business from occurrence coverage (which has a relatively longer average-time-to-payment) to claim-made coverage. However, a check of the split of premiums between the two forms of coverage does not suggest that such a change in mix occurred during the period. A second, more plausible explanation is that in the early years overly conservative assumptions were used to estimate the costs of the remaining claims. Companies gradually recognized that this was the case, and adjusted their estimates to reflect less conservative assumptions.

In addition to the trend, the variation across companies is quite significant. This is partially explained by differing mixes of business: claims-made versus occurrence coverage, doctors versus hospitals, etc. However, in addition, the payment patterns for an individual company are relatively unstable, changing more from one year to the next than we observed in the other two product lines.

Exhibit 5.4.2-A

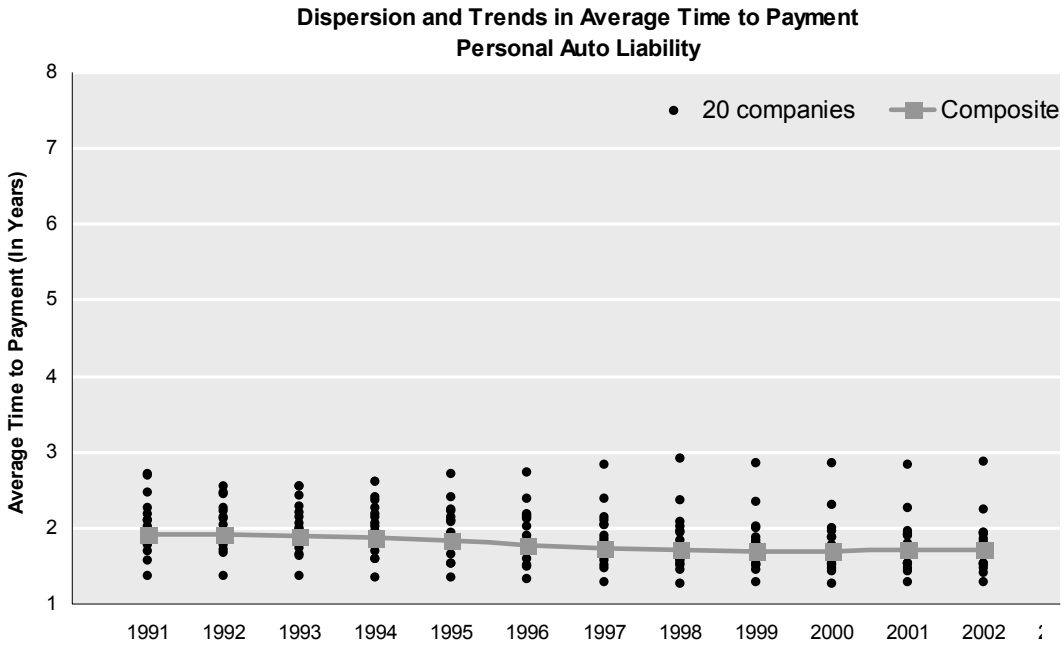


Exhibit 5.4.2-B

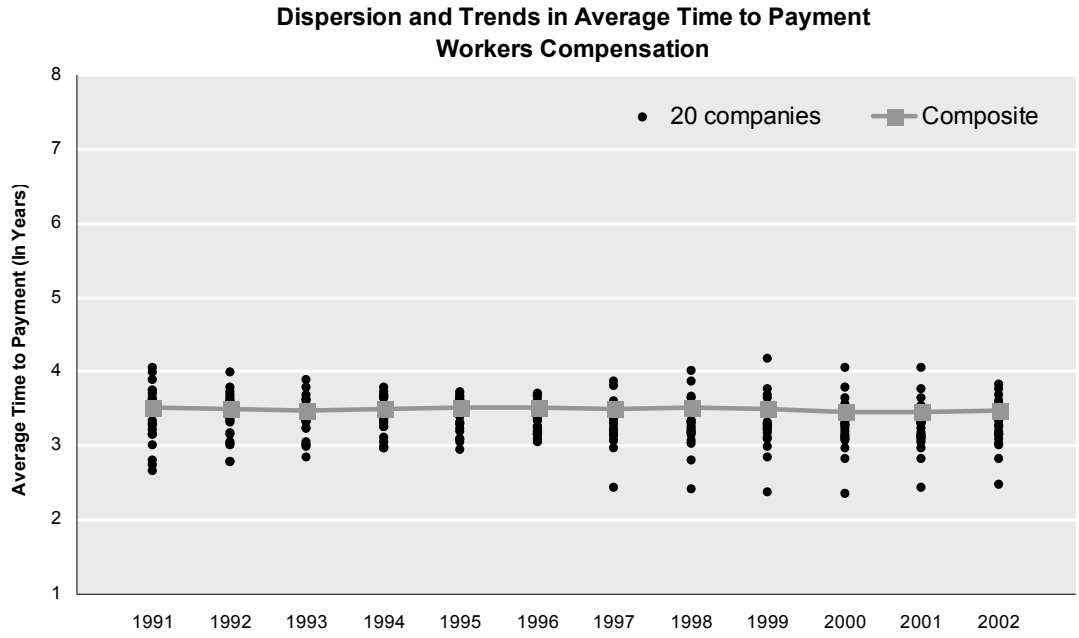
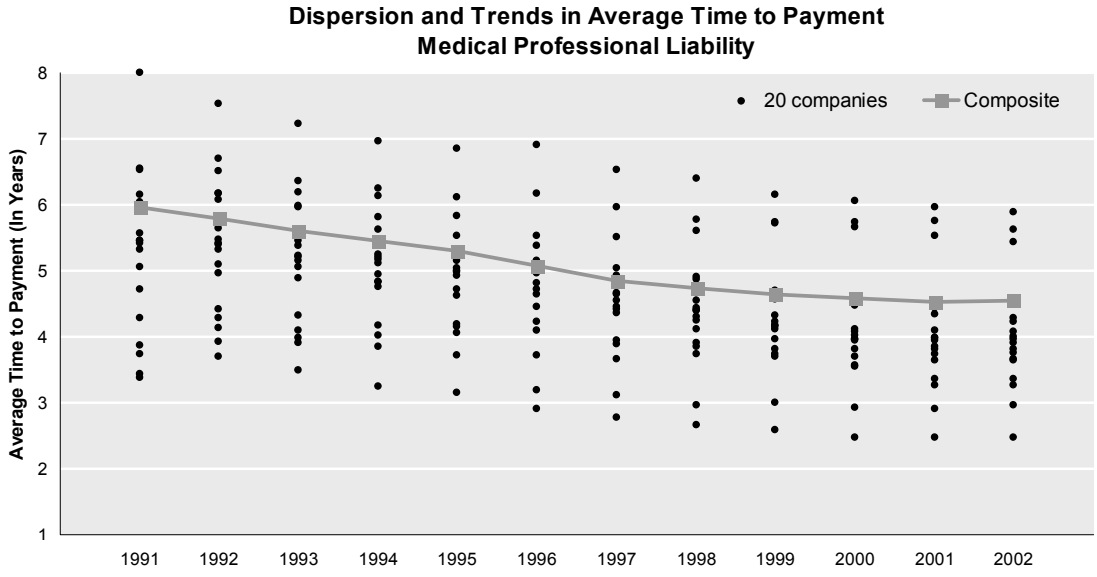


Exhibit 5.4.2-C



Selecting an Interest Rate for Discounting

For this research project, our approach was to discount the claim and defense cost liabilities at a risk-free rate, and then to develop an explicit market risk margin. As noted earlier, an equally acceptable approach would be to combine these two steps by developing a risk-adjusted rate and discounting the liabilities at that rate.

Rather than selecting a single risk-free rate and applying it to the cash flows at all maturities, we developed a risk-free rate applicable to the cash flow at each maturity, reflecting the slope in the yield curve. Conceptually, we developed a notional portfolio of risk-free assets with maturities that matched the expected liability cash flows; the current market value of these assets is the discounted value of the liabilities.

Several points regarding risk-free rates are worth noting in passing:

- Some have suggested that — even if an explicit risk margin is calculated — estimates of the fair value of claim and defense cost liabilities should be determined by discounting at other than the risk-free rate. They point out that insurers invest in a variety of assets, including investment grade corporate bonds, equities, mortgage-backed securities, and real estate. It is therefore possible that the market pricing of these liabilities by insurers might make use of a higher rate, reflective of the higher expected returns on these other asset classes.

- The fact that we developed the discount by constructing a notional matched portfolio of risk-free assets does not imply that the insurance industry actually invests in this manner, or that it necessarily should invest in this manner. The industry has historically held fixed investments with a duration longer than its liabilities in order to capture the higher yields associated with longer maturities.

- While rates on government instruments are often described as risk-free, this is true only in a narrow sense of the term. It would be more correct to describe government instruments as 'default-risk-free.' All fixed income instruments are subject to purchase-power risk: the risk that inflation will erode the real value of the principal during the time that the bond is held. (The presence of purchase-power risk is a major reason that the yield curve slopes upward with maturity.) In addition, government bonds are subject to liquidity risk.

- There is actually a wide choice of instruments to consider when setting the risk-free rate. These include government debt, swap rates, repurchase agreement rates, and even the highest-grade non-governmental debt. In the absence of market imperfections we should expect the results from each source to be similar. However empirical evidence has shown that this is not always the case. Development of the "best" measure of the risk-free rate is beyond the scope of this paper. While we have chosen to use rates based on U.S. Treasury securities for this project, we would note in passing that a wide range of recent academic research is coming to the view that rates based on government debt are not the best proxy for risk-free rates[26].

- Finally, it is worth noting that backing these liabilities with risk-free assets may not minimize risk from an overall asset-liability perspective. To the extent that the liabilities are inflation sensitive (which some almost certainly are), research has shown that the overall risk of the company is minimized by including some inflation sensitive assets in the portfolio.

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[26] For example, see Houweling and Vorst, "An Empirical Comparison of Default Swap Pricing Models" (Working paper, Erasmus Rotterdam University, 2002).

To obtain risk-free rates for this project, our starting point was yield-to-maturity data on zero-coupon bonds, obtained from Bloomberg. These bonds are synthetic; they are backed by U.S. Treasury securities, however the coupons on the underlying bonds have been stripped and sold separately. Because the Treasury securities backing them are held in trust, the synthetic securities have essentially the same credit characteristics as the Treasuries themselves. The principal advantage of the zero-coupon bonds is that they are traded in the open market.

Discount rates were developed based on the Bloomberg yield curves at each year-end from 1991 to 2002. Discount factors for prior time periods were developed from comparable yield curve data relating to constant maturity Treasury bonds, published by the Federal Reserve. The data used and additional technical details can be found in Appendix 8.2.

Applying the Discount Rates to the Projected Cash Flows

At each statement date, we applied the current discount rate for each maturity to the projected net claim and defense cost cash flows for each company group. Cash flows were assumed to occur at mid-year. We then compared the discounted and undiscounted values of the net liabilities, and computed an average discount factor. As a final step we applied the average discount factor to the reported direct claim and defense cost liabilities, as a first step toward adjusting them to a fair value basis.

The magnitude of the time-value-of-money adjustment varies with the level of interest rates. Exhibit 5.4.3 analyzes the impact of varying interest rates on the overall average discount factor for each of the three products. It displays the average discount factor (across all coverage years and the 20-company composite) that would have been developed if the current (i.e., year-end 2002) policy claim and defense cost liabilities were discounted at the historical market risk-free interest rates in effect at each year-end over the last 22 years. The three-year zero-coupon treasury rate is also shown as a benchmark. As can be seen, the amount of discount is much more significant historically than it is in the current interest rate environment. As interest rates have fallen from the high levels of the 1980s, the average discount factor has risen correspondingly. In the recent interest rate environment, the impact of discounting has ranged between 5% and 10% for Personal Auto Liability and 10% to 20% for Workers Compensation and Medical Professional Liability. If we take the interest rate levels of 1996 as being relatively "normative" then the impact of discounting would typically be about 8% for Personal Auto Liability, 17% for Workers Compensation, and 16% for Medical Professional Liability.

Exhibit 5.4.3

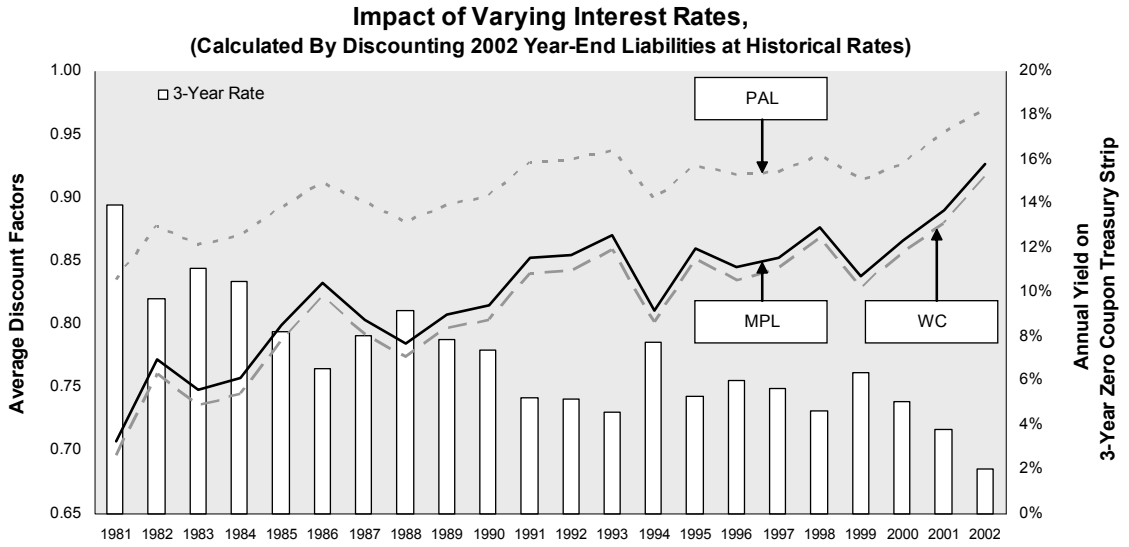


Exhibit 5.4.4 displays the dispersion of average discount factors across company groups and over time, including the 20-company composite. At any given statement date, average discount factors will vary by company group due to differing assumed payment patterns, and differing inventories of liabilities by coverage year. Over time, the discount factors will vary due to changes in interest rates, as well.

Exhibit 5.4.4-A

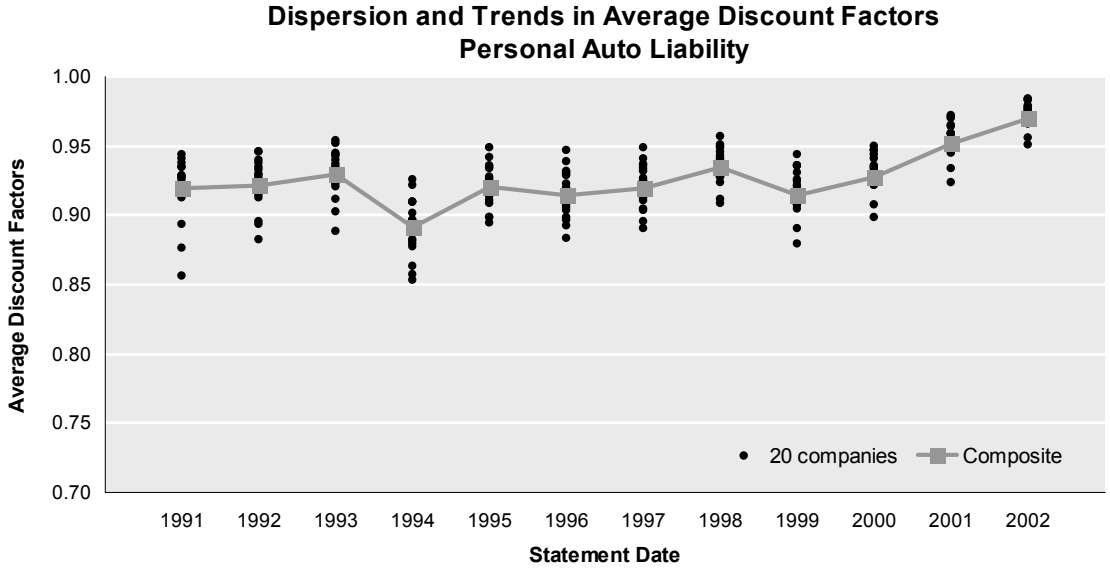


Exhibit 5.4.4-B

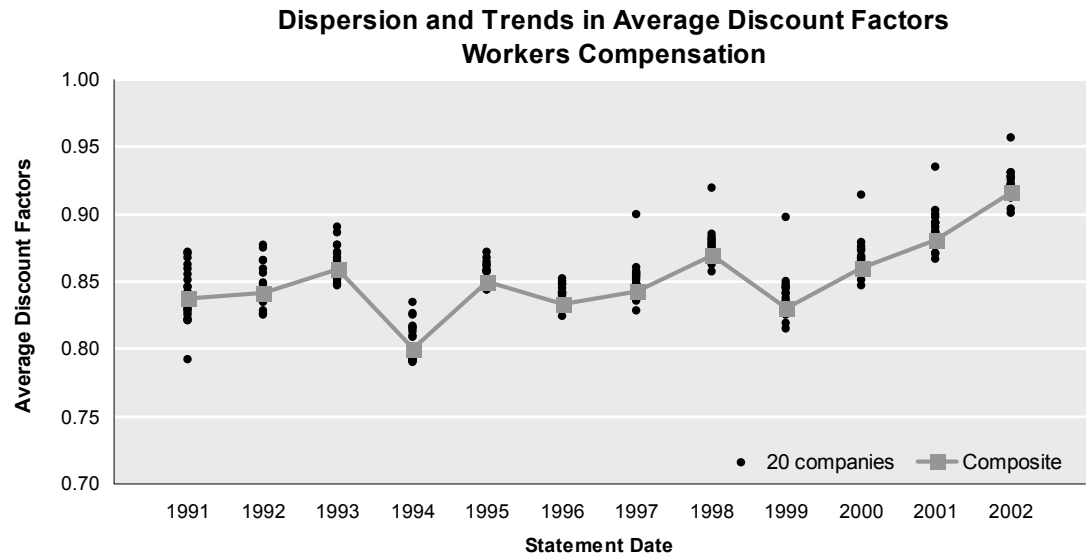
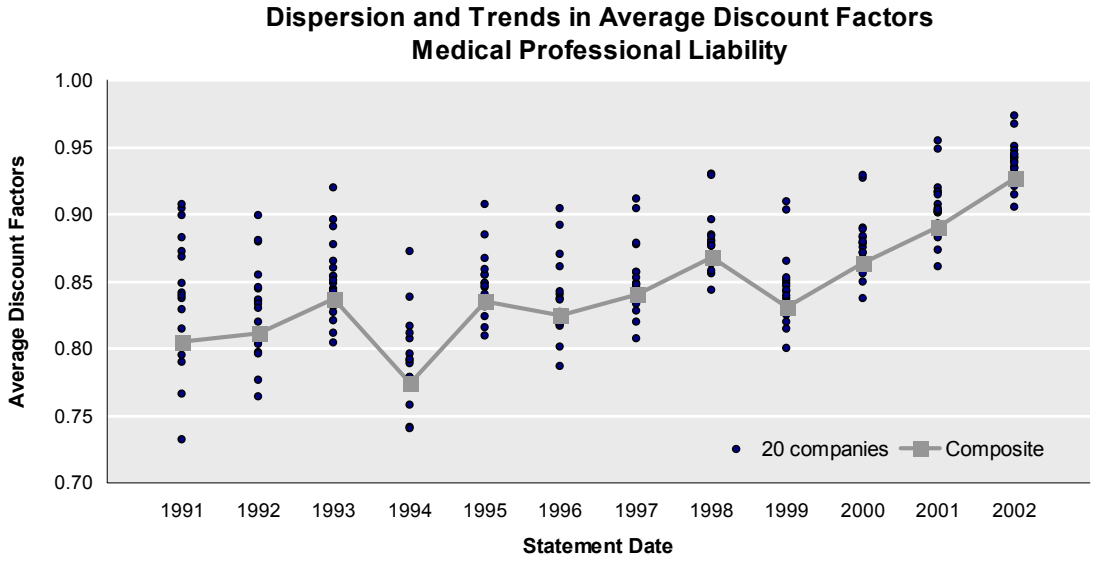


Exhibit 5.4.4-C



5.5 Market Risk Margins

Both the FASB and the IASB have indicated that estimates of the fair value of a financial asset or liability should include a margin reflecting the amount that marketplace participants would demand as compensation for systematic risk. (In this paper we refer to this margin as a market risk margin; others refer to it as a market value margin.) The economic rationale for a market risk margin is that an open market exchange would not occur at a price equal to the present value of the expected cash flows at the risk-free rate, unless the cash flows were also risk-free. To the extent that risk is present in the cash flows, rational buyers would demand a higher price to compensate them for that risk.

Issues Relating to the Definition and Measurement of Risk

While financial and actuarial literature are both consistently supportive of this conceptual proposition, there is a wide divergence of opinion as to what risks should be included and how market risk margins should be determined. The main areas of disagreement are (a) the degree to which market imperfections exist, and therefore the degree to which they need to be reflected in fair value estimates; and (b) the definition of systematic, or non-diversifiable risk, and how it should be measured and incorporated into fair value measures.

Statistically, diversifiable risk is defined as risk that can be reduced by volume through the operation of the law of large numbers. Property and casualty insurers are fundamentally in the business of diversifying risk. They write large volumes of similar policies (for example Personal Auto Liability insurance policies), with the risk of a claim on any given policy being largely independent of claims on the other policies. While the volatility of claims on an individual insurance policy is very high due to the random occurrence or non-occurrence of claims, the volatility of the claim experience for the overall portfolio of policies is relatively small. For most large auto insurers the remaining volatility of their claim experience is driven not by the randomness of the claims, but rather by factors that influence all of their insurance policies: changes in speed limits, improvements in highways, enforcement of drunk driving laws, introduction of safety features such as airbags, medical cost inflation, and so forth.

Separation of risk into diversifiable and non-diversifiable elements is important because economic theory makes a compelling case that market prices do not include a risk margin for diversifiable risk. In competitive, efficient markets, those that are diversified will simply bid prices down to eliminate any such margins. Market equilibrium will occur at prices that include only margins for risk that are not (practically) diversifiable.

The two standards bodies have indicated that market risk margins should be based on empirical market observation, and reflective of risks, market imperfections, and similar factors that are present in actual markets — not solely the risks that would be present in perfectly efficient markets. Efficient financial markets are characterized by (a) many buyers and sellers with free access to the market, similar risk appetites, and equal access to perfect information; (b) finely divisible transactions such that a single large transaction cannot distort the price; and (c) insignificant transaction costs, such that trading activity is unimpeded. Efficient markets are highly liquid with financial instruments that are actively traded; they are also devoid of information asymmetry that would advantage one trader over another. While many property and casualty insurance markets are highly competitive, the lack of a secondary market makes the financial liabilities created by them highly illiquid. Property and casualty insurance companies are not traders of these liabilities as envisioned by efficient market theory; in essence they are constricted to a "buy-and-hold" portfolio strategy.

Some would argue that the presence of these imperfections in the insurance market should lead to risk margins that are above those required by efficient markets; others would argue that these imperfections are largely irrelevant because the insurer's cost of capital (which must be financed by the risk margins in its insurance prices) is determined by the efficiency of the stock market. In essence, those espousing the latter view are arguing that property and casualty insurance market risk margins are driven (solely) by investor cost of capital

considerations, which can be determined (solely) from equity market efficiency considerations.

One must also exercise care in defining and measuring what constitutes systematic risk in the context of fair value. Financial economists tend to define systematic risk restrictively, to include only the risk associated with stock market returns. All other risk is considered to be non-systematic, or diversifiable. This approached is embodied in the Capital Asset Pricing Model (CAPM), which provides a theoretical framework for explaining how the risk associated with an individual stock is priced by the market. Under CAPM, risk is defined in terms of the degree to which an asset's return is linked to the overall stock market return. Assets with returns that are largely independent of the stock market will be priced by the market to produce expected returns close to the risk-free rate — because their risk can be diversified away through stock selection. By investing in a broad array of stocks, the independent volatility can be diversified away.

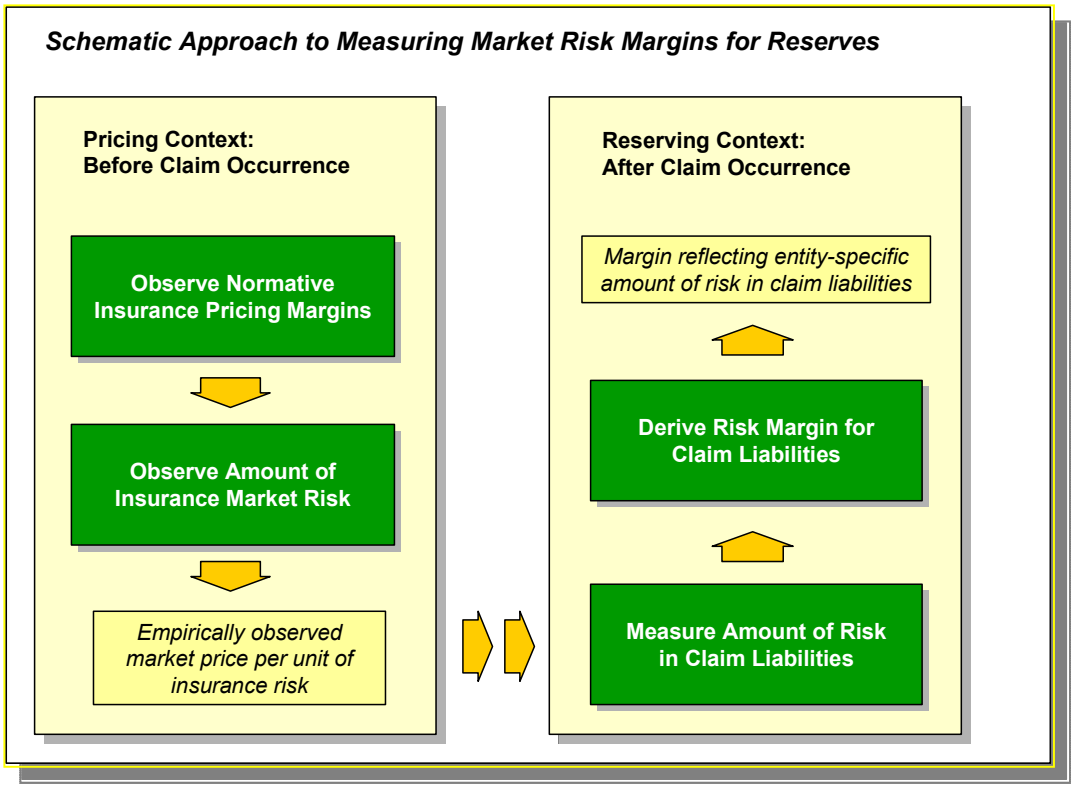
Of course, CAPM was developed in the context of individual stock selection and equity portfolio management. In CAPM, there is only one risk (stock returns), and only one class of assets (stocks). Others view stock market risk as one case of systematic risk and seek to generalize CAPM to incorporate more types of risk and more classes of assets. This approach is embodied in Arbitrage Pricing Theory (APT), in which individual asset prices are driven by a number of underlying systematic risk elements such as interest rates, energy prices, the level of economic activity, unemployment rates, wage inflation, and so forth. Under APT, risk is defined as the degree to which an individual asset's return is linked to each of these underlying risk elements. As with CAPM, assets with returns that are independent of one or more of these risk elements will have lower returns — because investors can construct portfolios that diversify independent risk. In addition, to the extent that assets exist with returns that are counter to one or more of these risk elements, investors can construct portfolios with natural hedges that will also act to bid down the price for those risks.

The importance of these definitional issues to property and casualty insurers is not whether diversifiable risk should have a risk margin associated with it under fair value. The answer to this question is clearly 'no' and methods for determining risk margins will need to be developed that differentiate between diversifiable and non-diversifiable risk. Rather, the key issue is whether the non-diversifiable element of insurance risk will be considered systematic, allowing a risk margin to be associated with it. The definitional choice of systematic risk can have a dramatic influence on the conclusions and results. For example, under a pure CAPM approach the risks associated with hurricanes and earthquakes (which are not fully diversifiable by the insurer, since they tend to affect multiple policyholders simultaneously) would not be considered systematic — because they are largely independent of stock market returns. This would imply that the market risk margin required for these risks can be determined merely as a provision that assures that the insurer obtains an after-tax return on its capital equal to the risk-free rate (i.e., a margin that covers any tax and agency costs). In contrast, a broader definition of systematic risk that includes non-diversifiable hurricane and earthquake risks would allow for a margin that incorporates these risks.

Overview of Our Approach to Measuring Market Risk Margins

For the purposes of this research project, our starting point was historical empirical evidence as to the actual market risk margin achieved in the insurance markets for each product. To

calculate market risk margins for claim and defense cost liabilities we took a four-step approach, as depicted in the graphic and described below:



- First, we calculated empirical market risk margins for the liabilities based on the prices that insurers actually charged at the time that the policies were sold. This was done for each product over a 27-year historical period by comparing the actual premiums charged in that year to the net present value of the actual expenses and policy benefit costs that were subsequently incurred. From the 27-year history we selected a normative market pricing risk margin.
- Second, we measured the amount of empirical non-diversifiable risk that is associated with the historical margin for each product, using the same time period and data. This allowed us to express the empirical market risk margins in terms of a market price per unit of non-diversifiable insurance risk.
- Third, we measured the amount of risk associated with each company's claim and defense cost liabilities at each statement date. (As a sensitivity test, we employed two different methods to measure the amount of risk.)
- Fourth, we applied the market price per unit of risk to the amount of risk present in the loss and defense cost liabilities to obtain a derived market reserve risk margin for each company at each statement date.

All of the above analysis was performed using data drawn from the Schedule P for each company group. Schedule P of the regulatory report provides a 10-year history of premiums and claim experience by year of coverage. For each product, Schedule P displays the

amounts of claim and defense payments, and the adjusters' estimates of the settlement cost of unpaid claims, for each year of coverage. Information is displayed at successive annual maturities, such that one can observe the emergence and settlement of claims over time. For mature years, one is able to observe the actual claim and defense costs associated with a particular year of coverage, rather than the initial estimates of those costs at the time the coverage was provided. Because Schedule P contains 10 years of history (that is, the current year plus nine prior years), our 12 years of financial reports yielded 21 years of coverage experience.

Each of the steps outlined above is discussed more fully below, with additional technical details provided in Appendix 8.3.

Empirical Market Pricing Risk Margins

Our starting point was empirical evidence as to the margins that were actually present historically in the prices charged in the insurance market for each product. For each historical year of coverage, we deducted the present value (discounted at the then-prevailing risk-free rate) of actual acquisition, underwriting and claim adjusting expenses from the actual premium revenue. The net amount remaining (i.e., the *pure premium)* represents the provision for claim and defense costs, including any margin that the market allows insurers to charge for taking the risk. We then deducted the net present value of the actual claim and defense costs. Any net remainder would presumably represent the margin for risk that was allowed by the market. Several points should be noted:

- The resulting empirical market risk margins are ex-post measures, in the sense that we are looking at the actual realizations of claims, rather than the market expectations. This approach is analogous to measuring the equity risk premium by looking at actual equity returns over an extended period. Generally, ex-post measures reflecting actual realizations are easier to obtain than ex-ante measures reflecting their expectation.

- Since the prices for the insurance products were set before the coverage was provided and the claims occurred, the resulting empirical market risk margins are indicative of the level of risk at that point. Actuaries would refer to this level of risk as *pricing risk*, rather than *reserve risk*. The latter is presumably a subset of the former, as the claim reserves relate to liabilities for events that have already happened. In theory, the level of risk is greatest at the time the policy is issued; the risk then gradually dissipates as the coverage is provided, the insured events occur, the claims are initially reported, and the information necessary to settle them is developed. At each stage of maturity, the level of risk should reduce as uncertainties are eliminated and information about the claims and their ultimate settlement costs become known.

Empirical pricing risk margins are calculated for coverage years from 1976 to 2002 (i.e., over a 27 year period). As a proxy for the market we used the historical experience for the composite of the 20 companies going back to 1982, and supplemented that data with published industry results from 1976 to 1981.

A special issue emerged with Personal Auto Liability. For most customers, this coverage is purchased in conjunction with Personal Auto Physical Damage coverage. Insurers are concerned primarily with the margin on the overall contract, including both coverages. At certain times, competitive and regulatory considerations may cause insurers to accept a sub-

par return on one of the coverages in exchange for an attractive return on the other. We therefore analyzed the empirical pricing risk margins on the two coverages combined.

The empirical market pricing risk margins, expressed as a ratio to the pure premium, for each product are displayed in Exhibit 5.5.1. One can see immediately that they are volatile and cyclical, reflecting the dynamics of the markets for each of the products. Variations in the pricing risk margins over time can be caused by (a) market mis-estimation of the expected claim and defense costs at the time the product was priced, especially when there is a change in the underlying trends affecting the claim costs; (b) periods of alternating over-supply and under-supply in the market, with the former leading to the bidding down of prices to a point below expected costs as participants attempted to protect their market share; (c) rate suppression by regulatory authorities in various jurisdictions, particularly in times of high inflation causing the need for large increases; (d) high levels of investment returns, which add to capital and bolster performance, in turn causing companies to bid for business more aggressively.

Margins for Personal Auto are the most stable, with only a few periods indicating negative margins. Workers Compensation is more volatile (note the changes in the scale of the left axis from one product to another), with periods of substantial margins and periods of small or negative margins. Medical Professional Liability is more volatile still, showing an extended period of substantially negative margins over the latest seven years.

Exhibit 5.5.1-A

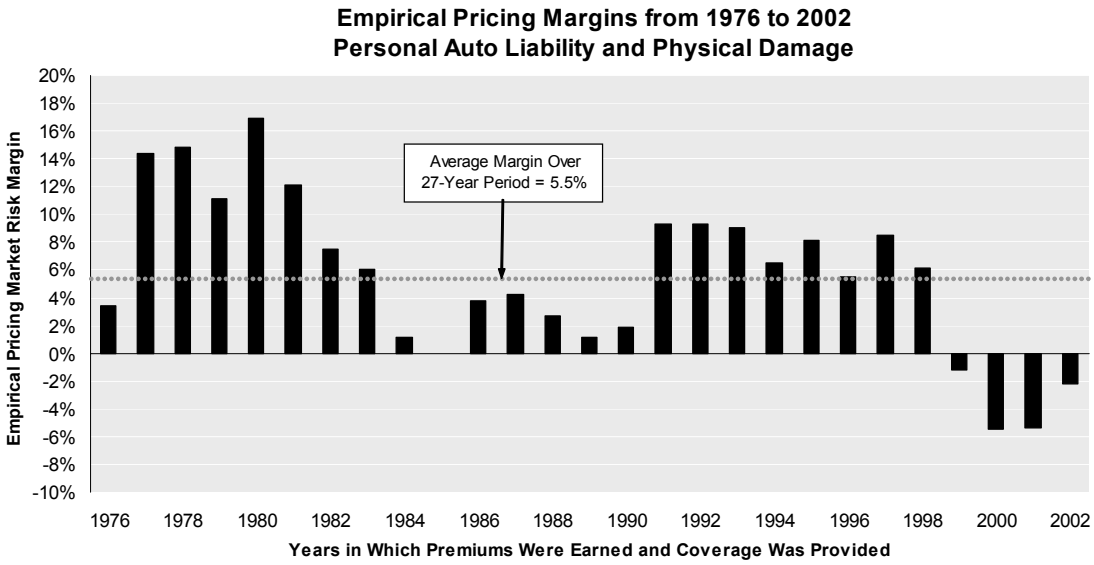


Exhibit 5.5.1-B

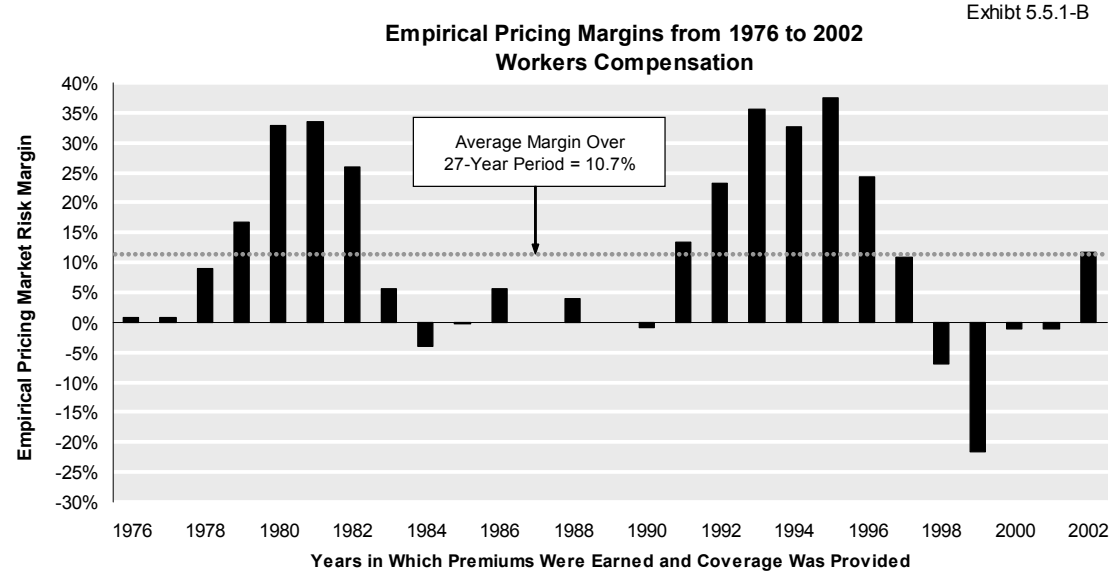
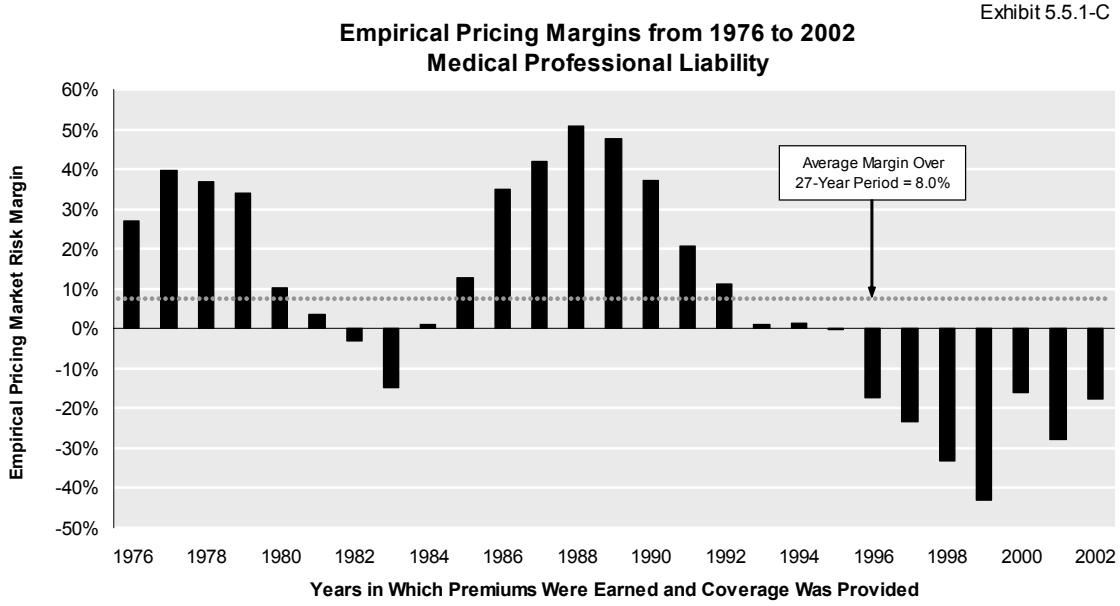


Exhibit 5.5.1-C



Our goal was not to measure the market pricing risk margin at any given point, but rather to develop an estimate on the long-term normative market pricing risk margin. We calculated the average market pricing risk margin over various historical periods. Due to their volatility, the average historical market pricing risk margins are somewhat dependent on the specific time period chosen. (An analogous issue occurs when analyzing historical equity returns.) Ultimately, we selected a normative market pricing risk margin for each line judgmentally, based on risk-return considerations (discussed below). The values we selected are meant to be reasonable, but illustrative. Further research could help to refine estimates of the market pricing risk margins.

In passing, we would note that we could have allocated capital to each product, and converted the empirical margins into a return on capital. While this would have allowed us to make comparisons to returns on other financial instruments such as stocks and bonds, it

would have depended on our assumptions as to the required level of capital. We therefore chose to simply look at the margins as a percent of revenue.

Using the same data for the period 1982 to 2002, we measured the empirical market volatility associated with the empirical pricing risk margin of each product. We measured the volatility over time and across the 20 companies. Exhibit 5.5.2 displays the results graphically. As can be seen, the volatility of the market pricing risk margins is relatively small for Personal Auto, somewhat larger for Workers Compensation, and very significant for Medical Professional Liability (the left hand scale has been kept constant to permit visual comparisons between the lines). In Personal Auto the variation is relatively uniform across all company groups, with no outliers. However, in Workers Compensation, two company groups appear to be outliers, exhibiting greater volatility. In Medical Professional Liability a number of company groups also exhibit significant volatility.

The empirical volatility observed in Exhibit 5.5.2 includes systematic risk due to the behavior of the markets and the underlying economic environment. It also includes some residual non-systematic risk due to the random nature of claims (particularly large claims). Since we excluded companies with very small volumes of business from our sample, most of the non-systematic risk will have been diversified away. In addition, since the data are net of reinsurance they reflect the extent of risk hedging that companies typically purchase. We are not aware of a method to empirically separate the systematic risk from the residual non-systematic risk.

Exhibit 5.5.2-A

Empirical Pricing Volatility for Personal Auto Liability and Physical Damage

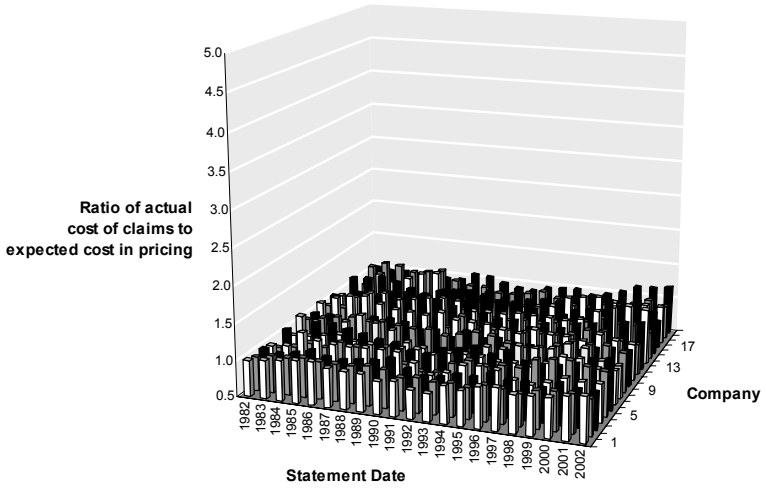


Exhibit 5.5.2-B

Empirical Pricing Volatility for Workers Compensation

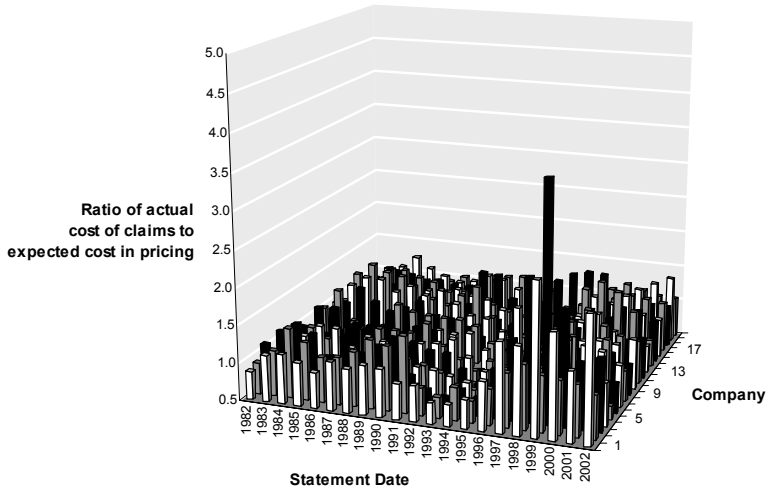
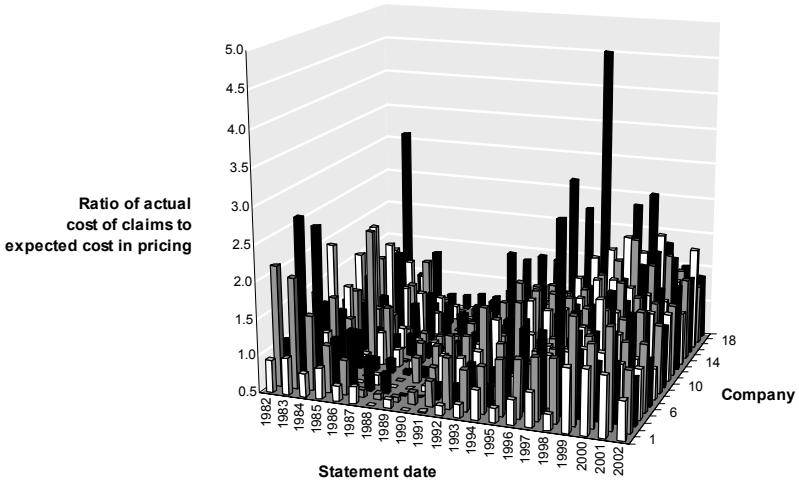


Exhibit 5.5.2-C

Empirical Pricing Volatility for Medical Professional Liability



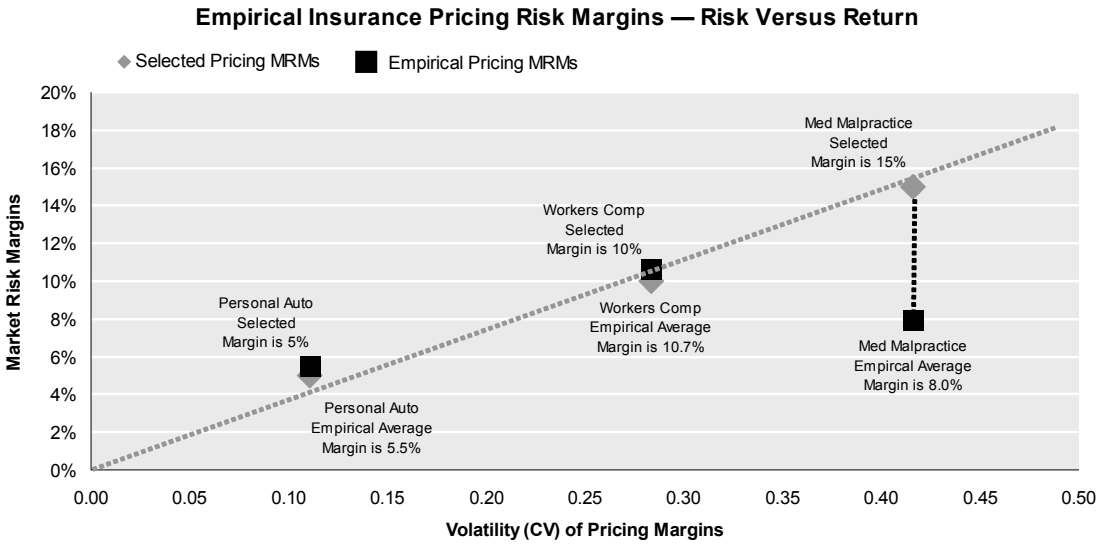
Our chosen measure of volatility was the standard deviation of the margins expressed as a percentage on the net present value of the expected claim and defense cash flows (statistically, the coefficient of variation). Using this measure, the market pricing risk margin volatilities are 11.1% for Personal Auto, 28.3% for Workers Compensation, and 41.6% for Medical Professional Liability.

Exhibit 5.5.3 combines the overall results for each line in a risk-return framework, showing both the empirical historical average market pricing risk margins and our selections of their normative values.

One would expect that the market would allow greater margins for greater risk; however, this is not the case for Medical Professional Liability. The latter product has been particularly problematic over the last several decades, as it suffered from very high inflation

in claim costs. Many insurers have withdrawn from the market for this product because they do not believe that they can achieve acceptable returns. We would therefore conclude that the historical experience is not representative of the required returns for this product. As can be seen on the exhibit, we chose normative market pricing risk margins of 5%, 10%, and 15% for Auto Liability, Workers Compensation, and Medical Professional Liability, respectively. The choice of round numbers with an approximate linear relationship between risk and return is indicative of the accuracy of the estimates. Here again, further research should help to improve the measurement of these relationships.

Exhibit 5.5.3



Finally, by dividing the selected normative market pricing risk margin by the coefficient of variation, we obtained a measure of the normative market price per unit of risk for each line. These are approximately 450 basis points for Personal Auto, 350 basis points for Workers Compensation, and 360 basis points for Medical Professional Liability. (Recall that the margins are a return on sales, rather than return on capital, such that they are not directly comparable to risk premia on different classes of investment.)

Measuring Reserving Risk and Deriving Market Reserve Risk Margins

Having developed normative empirical market pricing risk margins, we turned our attention to the measurement of the amount of risk present in the claim and defense cost liabilities. Our goal was to develop a measure of the amount of risk for the total inventory of unpaid claims for each entity, rather than the amount of risk associated with the unpaid claims by coverage year. We would expect that the amount of risk present in the liabilities for each coverage year would decline with older, more mature coverage years — due to the decreasing uncertainty discussed earlier. Our methodology could easily be refined to reflect varying amounts of risk by coverage year. We measured the total amount of reserving risk for each company group at each statement date, using two different generally accepted stochastic reserving methods. Two methods are used to illustrate the differences in results that might be obtained.

- The first method is an analytic approach, as published by Mack[27]. Using the historical claim development data, the standard error of the estimated claim and defense cost liabilities is computed based on certain underlying statistical assumptions as to the underlying claim process.
- The second method is a stochastic simulation approach, as published by Hodes, Feldblum, and Blumsohn[28] (referred to subsequently in this paper as the HFB method). Parameters are derived from the company group's historical claim development data; future claim and defense cost payments are then simulated via random draws from a set of assumed statistical distributions having the derived parameters. The result is a sample distribution of projected future cash flows, which can be adjusted to a present value basis by discounting at the risk-free rate.

As has been indicated, both of the above methods utilize the same historical data. Both methods incorporate risks as to the timing and the amounts of future cash flows. However, our results indicate that the two methods produce different indications as to the amount of reserving risk present at each company group.

Each of the two methods, and their application in the context of this project, are described more fully in Appendix 8.3.

As a final step, we applied the selected market price per unit of risk to the indicated amount of reserving risk to produce a derived market reserving risk margin. Consistent, with fair value principles, while the reserving risk margin reflects the entity-specific amount of risk for a given product, the margin reflects only a market cost of risk rather than a company (entity-specific) cost of risk.

Exhibit 5.5.4 displays in bar chart format the derived reserving risk margins for the 20-company composite at each statement date for each of the three product lines. Results are shown for both the Mack and the HFB methods. As can be seen, the derived reserving risk margins are different between the two methods. They also vary over time, due to changing parameters derived from the emerging claim development experience. The charts also show (as a horizontal dashed line) the selected market pricing risk margin. As would be expected, the reserving risk margins are a fraction of the pricing risk margins. The pricing risk margins reflect the level of risk that is present at the time the product was sold, before any of the insured events have happened. The reserve risk is therefore a residual; as events unfold and more information becomes available, the risk should decline.

In reviewing Exhibit 5.5.4, note that the composite results shown are the weighted average of the individual company group margins, and not the margin derived from the composite data.

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[27] Thomas Mack, "Measuring the Variability of Chain Ladder Reserve Estimates", *CAS Prize Paper Competition on Variability of Loss Reserves* (1993, p. 102-182).

[28] Douglas Hodes, Sholom Feldblum, and Gary Blumsohn, "Workers Compensation Reserve Uncertainty", *Proceedings of the Casualty Actuarial Society, Volume LXXXVI* (p. 263-392).

Exhibit 5.5.4-A

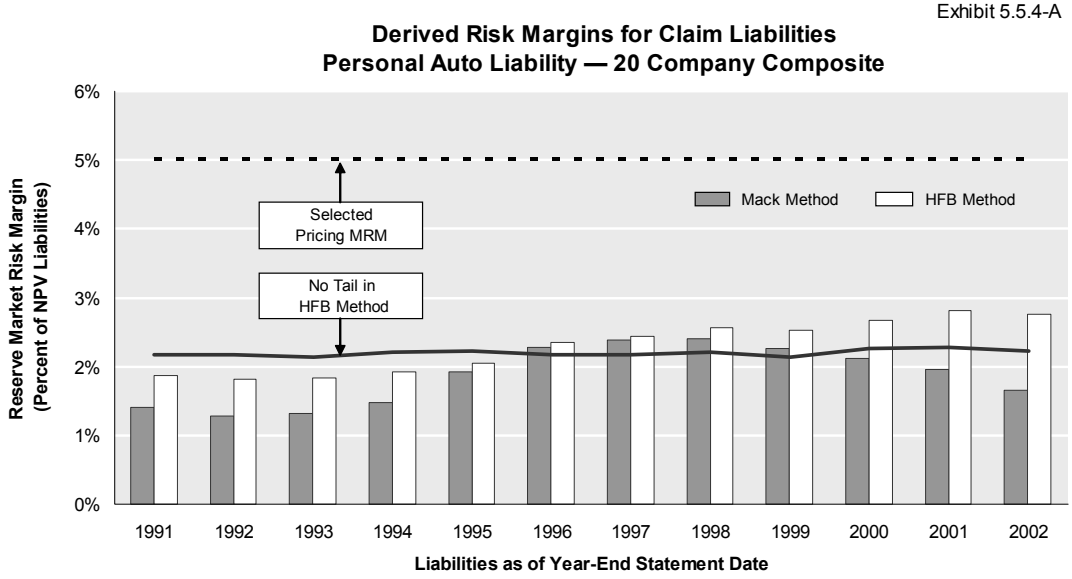


Exhibit 5.5.4-B

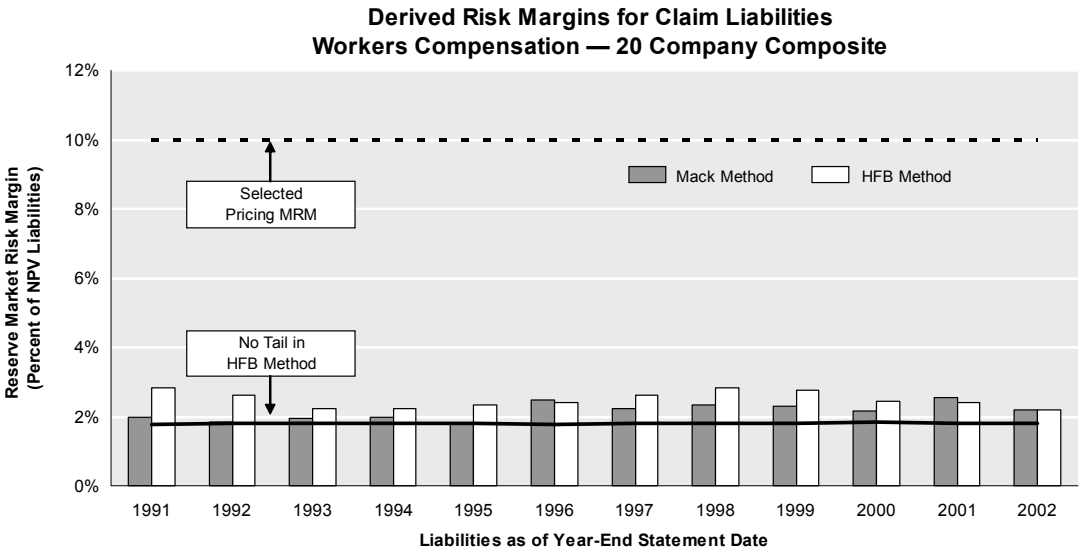
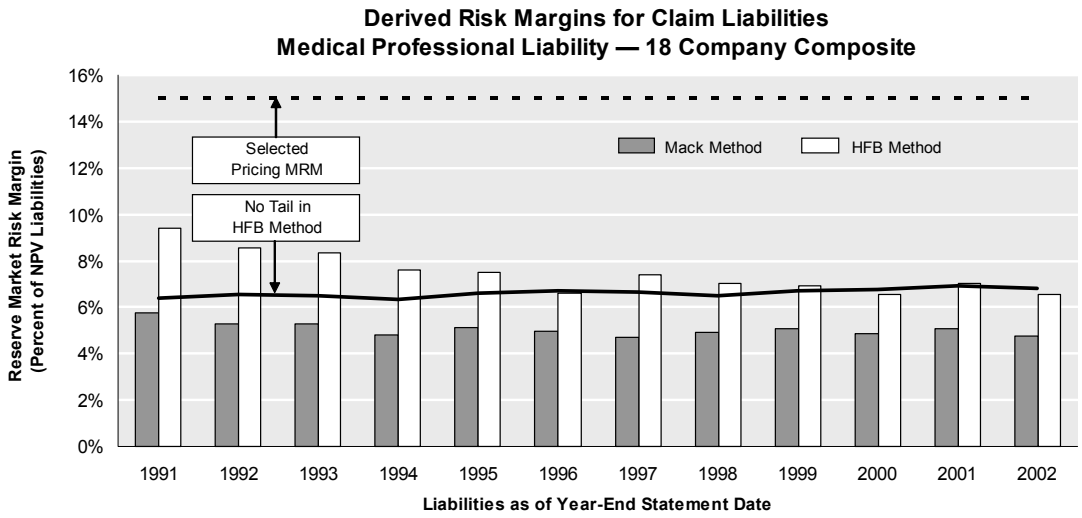


Exhibit 5.5.4-C



For all three lines, the market reserve risk margins produced by the HFB method are higher than those produced by the Mack method. To the extent that there are outlier values, the HFB method is more responsive to them — creating higher measures of reserve variability. Moreover, the HFB method assumes development beyond the tenth maturity (i.e., where our data stops), whereas our implementation of the Mack method does not. The uncertainty of the development beyond the tenth maturity has a leveraged effect on the measured uncertainty. For comparison purposes, we performed alternative calculations using the HFB method in which we assumed that there was no development beyond the tenth maturity. These are shown as a solid line on Exhibit 5.5.4. As can be seen, eliminating the "tail" uncertainty from the HFB method lowers and stabilizes the measured uncertainty. In fact, removing the tail uncertainty in Workers Compensation moves the market reserve risk margin indicated by the HFB method below that indicated by the Mack method.

Exhibit 5.5.5 displays the dispersion of individual companies around the composite at each statement date, as well as the trends over time, of the measured market reserve risk margins using the HFB method. Note that a few companies (two for Personal Auto Liability and four for Medical Professional Liability) have a derived market reserve market risk margin that is in excess of the selected normative market pricing risk margin – indicating that their amount of reserving risk is greater than the assumed amount of market pricing risk. This is an unusual result, given our hypothesis that the amount of risk declines as information about the claims becomes known. In theory, these companies would record a loss on the sale of new business, as they would be required to record claim and defense cost liabilities with a market reserve risk margin in excess of the allowance in market prices for the particular product.

Exhibit 5.5.5-A

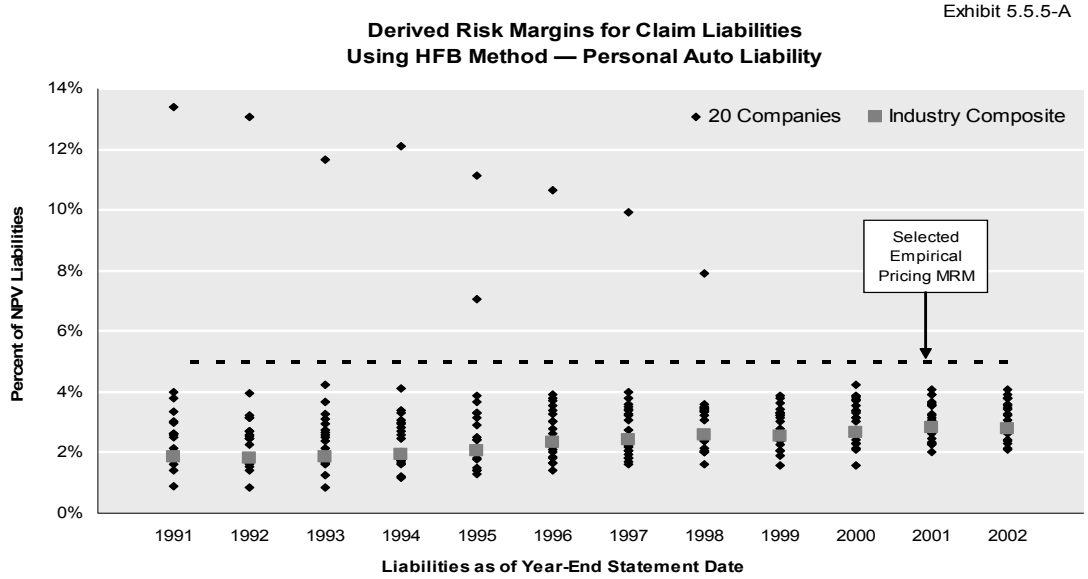


Exhibit 5.5.5-B

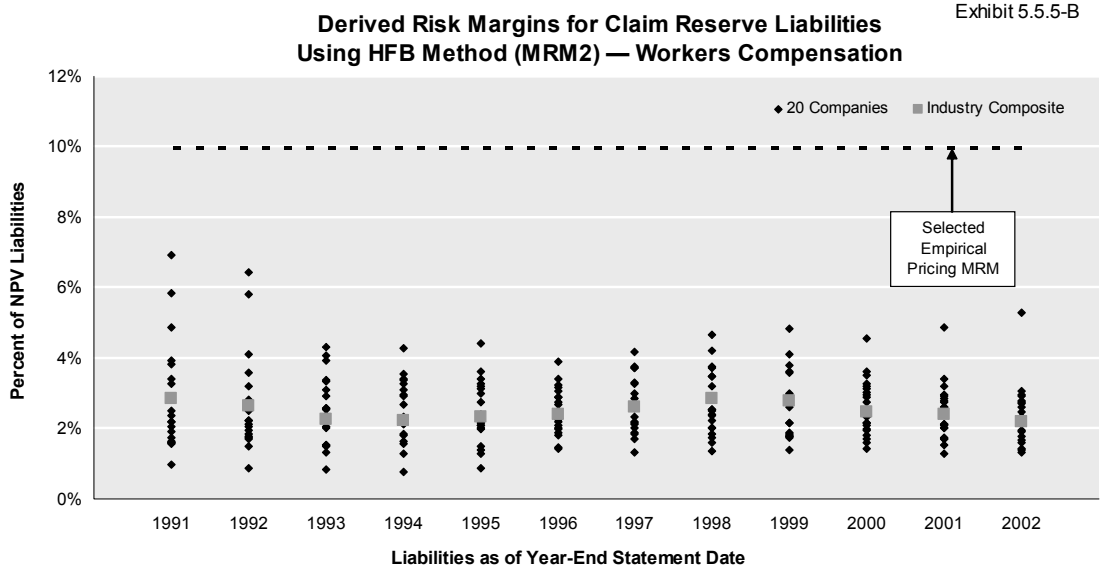
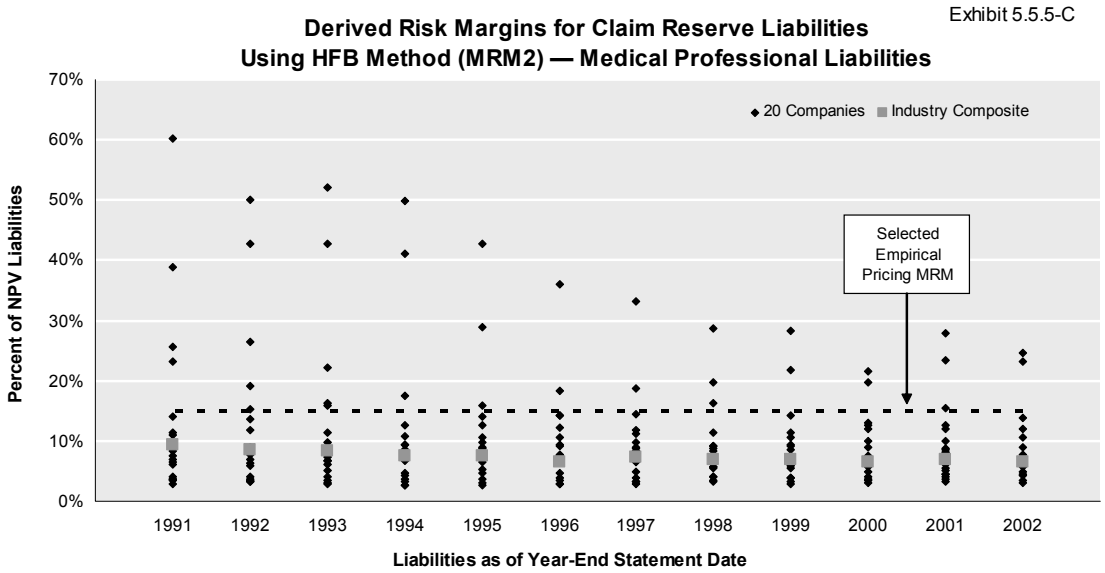


Exhibit 5.5.5-C



We wanted to test whether the size of the company (as measured by its premium volume for the particular product) had an influence on the measured reserve risk. Our hypothesis was that larger companies enjoy a greater level of diversification of risk, and that smaller companies still have some undiversified non-systematic risk present in their business. To test this hypothesis, we segmented the company groups into three tiers based on their premium volume for each product. For each tier, we calculated an average of the measured reserve risk across all companies in the tier and all statement years, using premium volume as our weights. The resulting average market reserve risk margins by tier are shown in Exhibit 5.5.6. As can be seen, the level of measured reserve risk does increase as the company size diminishes, suggesting that we are still capturing some process risk in the smaller companies. Since process risk is diversifiable, economic theory argues that the market will not pay a risk premium for it. However, the data reflects the level of diversification that actually exists in the market — further diversification (for example, via mergers that create larger, more diversified portfolios) may not be practical for structural reasons.

Average Reserve Market Risk Margins -- By Size of Company Exhibit 5.5.6

		Composite of Measured Reserve Risk Across Companies and Years			
Product	**Size Tier**	**Mack Method**	**Ratio to Largest**	**HFB Method**	**Ratio to Largest**
Personal Auto Liability	Smallest	0.028	1.56	0.036	1.64
	Middle	0.023	1.28	0.027	1.23
	Largest	0.018	1.00	0.022	1.00
Workers Compensation	Smallest	0.022	1.05	0.029	1.16
	Middle	0.023	1.10	0.024	0.96
	Largest	0.021	1.00	0.025	1.00
Medical Prof. Liability	Smallest	0.076	1.73	0.111	1.68
	Middle	0.058	1.32	0.076	1.15
	Largest	0.044	1.00	0.066	1.00

Finally, Exhibit 5.5.7 summarizes the volatility of individual company group reserve risk margins. In each column, the company groups have been sorted in descending order in terms of the stability of their measured reserve volatility (the results for the 20-company composite are shown in bold). The statistic shown is the square root of the sum of the squares in the annual change in the market reserve risk margin from one year to the next. As can be seen, the companies vary dramatically as to the stability of their measured reserve risk, using either of the two methods. Generally the HFB method is less stable. As we have noted, the HFB method is somewhat more responsive to outlier values in the claim experience data. It also incorporates an element for the volatility of the tail of unpaid claims beyond 10 years maturity. (These are not meant as criticisms of the HFB method; they are simply observations as to the drivers of the differences between the methods.)

Stability of Reserve Market Risk Margins Over Time Exhibit 5.5.7

Company Rank	Personal Auto Liability		Workers Compensation		Medical Prof. Liability	
	Mack	HFB	Mack	HFB	Mack	HFB
1	0.0441	0.0580	0.0756	0.0536	0.1784	0.3026
2	0.0352	0.0542	0.0643	0.0298	0.0893	0.2353
3	0.0301	0.0141	0.0545	0.0296	0.0777	0.1165
4	0.0222	0.0117	0.0525	0.0217	0.0753	0.1153
5	0.0189	0.0114	0.0223	0.0212	0.0691	0.0856
6	0.0153	0.0102	0.0218	0.0207	0.0585	0.0746
7	0.0149	0.0101	0.0188	0.0199	0.0554	0.0741
8	0.0130	0.0097	0.0179	0.0165	0.0455	0.0737
9	0.0124	0.0091	0.0148	0.0157	0.0441	0.0592
10	0.0122	0.0087	0.0136	0.0140	0.0438	0.0402
11	0.0118	0.0084	0.0135	0.0100	0.0354	0.0351
12	0.0112	0.0080	0.0128	0.0097	0.0334	0.0273
13	0.0110	0.0073	0.0123	0.0096	0.0325	0.0248
14	0.0087	0.0070	0.0106	0.0093	0.0243	0.0238
15	0.0077	0.0069	0.0105	0.0079	0.0196	0.0237
16	0.0077	0.0068	**0.0095**	0.0070	0.0175	0.0224
17	**0.0073**	0.0067	0.0095	**0.0067**	0.0127	**0.0188**
18	0.0071	0.0066	0.0079	0.0066	**0.0094**	0.0158
19	0.0069	0.0056	0.0069	0.0064	0.0066	0.0108
20	0.0061	0.0056	0.0056	0.0064		
21	0.0037	**0.0044**	0.0043	0.0032		