An Investigation of Practical Matters Related to Implementing Fair Value Accounting for Property/Casualty Loss Reserves

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PRICEWATERHOUSECOOPERS

Abstract

The Casualty Actuarial Society (CAS) engaged PricewaterhouseCoopers LLP (PwC) to identify and consider the actuarial issues property/casualty insurance companies may encounter by presenting financial results under a fair value accounting standard. The foundation of International Accounting Standards Board (IASB) proposals is that insurance assets and liabilities should be shown in the financial statements at 'fair values' (i.e. market values where a market exists), which differs from current U.S. generally accepted accounting principles (GAAP). This study focuses strictly on the impact fair value accounting could have on loss and loss adjustment expense reserve levels for three specified lines of property/casualty business. We have not considered the impact fair value accounting may have on unexpired risk reserves, any other liabilities, or any assets.

Keywords

Fair value; Loss Reserves; Market Value Margins; International Financial Reporting Standards; Property/Casualty insurance

Background

During the 1980s, many U.S. banks recorded assets at book value, allowing them to increase reported equity by selling assets with market values above book value. This left many banks holding portfolios of assets with market values below book value. This practice of recording assets at book value masked the true financial position of many of the banks, allowing the extent of their insolvency to grow before it was realized by the market.

The United States Financial Accounting Standards Board (FASB) subsequently introduced reporting of assets at market value. Many groups were concerned with the resulting inconsistency between asset and liability valuations, with no fair value liability valuation methods being available at the time. The FASB did not accept the argument that implementation of valuing assets at fair value should thus be aborted, and has continued toward implementing valuation of liabilities on a 'fair value' basis. Around the same time, the International Accounting Standards Committee (which is now called the International Accounting Standards Board, or IASB) was developing an accounting standard for insurance using similar market value principles. The standards issued by the IASB are known as International Financial Reporting Standards (IFRS).

The CAS engaged PwC to consider the issues property/casualty insurance companies may face when producing financial statements based on fair value accounting standards. Fair value has been defined as the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction. Stated another way, fair value is equivalent to a market value (e.g., stocks and bonds valued at their current market value), or at an estimated market value if a sufficiently active market does not exist.

A sufficiently active market currently does not exist for property/casualty insurance loss and loss adjustment expense (LAE) reserves, as they are not traded in an open market like selected assets (e.g. stocks, bonds). Therefore, the market value of loss and LAE reserves should be evaluated based on the application of fair value principles using actuarial methods and models.

The majority of actuarial papers and articles published to date on the topic of fair value accounting for property/casualty insurance companies have focused on the theoretical aspects and conceptual framework of such modeling. The objective of the CAS project was to launch practical research for an application of some of these theories and concepts to real sets of claims data, and evaluate the impact they could have on the financial statements of 'typical' US property/casualty insurers that were intended to represent a cross-section of the industry.

This paper presents our findings of this research project, subject to the project parameters described in the Scope & Objectives section. Due to the nature of the source for the data used in this study (that is, statutory-basis Schedule P data), all references to loss reserves in this paper should be considered to mean loss and defense and cost containment expense reserves.

This paper should not be regarded as representing the views of the Casualty Actuarial Society or of the authors' employer. This paper should be read in its entirety as reading individual sections out of context may be misleading. We hope that this paper will be used as a basis to promote further work and discussion in this important area. Our analysis and findings in this paper should not be relied upon in application to the financial statements of any company. As such, we assume no liability in respect of the implementation of the methods or models described herein, nor the consequences of applying such methods and models.

A list of technical definitions and abbreviations used in this paper is given as part of the Appendix.

Scope & Objectives

The Casualty Actuarial Society (CAS) engaged PricewaterhouseCoopers LLP (PwC) to identify and consider the potential impact on a typical U.S. property/casualty insurance company's financial statements of changing from current U.S. generally accepted accounting principles (GAAP) to "fair value" accounting for valuing loss reserves. A central theme of International Accounting Standards Board (IASB) proposed accounting standards to date is that assets and liabilities should be valued at a "fair value." Fair value is defined as valuing assets and liabilities at a market value (e.g. stocks and bonds valued at their current market value), or at an estimated market value if a sufficiently active market does not exist.

The CAS requested that this study focus on the following two objectives:

- Compare typical property/casualty insurer financial statements, representing a cross-section of the industry, under current U.S. GAAP rules and a fair value accounting standard for valuing loss reserves.
- Discuss the major actuarial issues that might arise with respect to presenting property/casualty insurance financial statements using a fair value accounting basis for loss reserves.

Loss reserves are currently not traded in an open market like selected assets (e.g. stocks, bonds), and as a result a sufficiently active trading market currently does not exist. Therefore, the market value of loss reserves should be evaluated on the basis of the application of fair value principles using actuarial methods and models.

Our general approach to estimating loss reserves on a fair value basis was to:

- Begin with undiscounted reserve levels,
- Discount the reserves to account for the estimated time value of money, and
- Add an estimated margin for risk and uncertainty.

In this paper, we use the term "market value margin" (MVM) to refer to the estimated margin for risk and uncertainty in excess of the discounted loss reserves that would be required by a willing buyer in an arms-length transaction to assume the liabilities the loss reserves are held to meet.

U.S. GAAP Reserves	**Fair Value Reserves**	**Fair Value Reserves**
Undiscounted reserves	Undiscounted Reserves - Discount Amount + MVM Amount	Undiscounted Reserves x (1 - Discount %) x (1 + MVM %)

References to "fair value loss reserves" in this paper should be taken to mean loss reserves after the adjustments for discounting and MVM have been applied.

There are several generally accepted approaches to selecting the interest rate(s) to discount the loss reserves for anticipated investment income. The CAS requested that we utilize at least one of the following two approaches:

- Apply a risk-free interest rate that is associated with the duration of the projected future cash flow of the liabilities (i.e., duration approach);
- Apply a schedule of risk-free interest rates matching the projected future cash flows (i.e., yield curve approach).

The CAS requested that we estimate the MVM percentages under at least two different approaches:

- Percentile of an aggregate probability distribution of reserve values;
- The mean reserve value plus a margin proportional to the standard deviation of the estimated reserve distribution.

The CAS set forth the following data guidelines:

- The analysis should focus on three lines of business:
    a. Personal auto liability
    b. Workers' compensation
    c. Medical malpractice claims-made
- The data should be publicly available
- The data should be at annual periods of exposure and valuation
- The data should be on an accident year basis
- The data should include loss and loss adjustment expense

We should note several additional key limitations to the scope of this project. These included:

- The impact of any entity-specific credit risk on a company's required MVM, such as might be measured by a company's credit rating, should not be considered.
- The adequacy of the booked loss and loss adjustment expense reserves forming the base data should be assumed to be reasonable (i.e., the recorded reserves should be considered an actuarial best estimate).
- Any adjustments to the MVM that might be made to account for the correlation across lines of business for multi-line insurers should not be considered.
- The study should focus strictly on the potential impact fair value accounting could have on loss reserve levels. As a result we have not considered the impact fair value accounting may have on unexpired risk reserves, other liability accruals, or any asset values.

Executive Summary

Findings

Our findings are based solely on the results of our testing using the specified data sets for three lines of business, the selected experience period, and the selected models, for the sample of companies that we selected. Our findings are based on a limited sample of companies and a specified collection of scenarios (e.g., sets of assumptions), and thus may not be appropriate or extendable for all companies.

We also emphasize to the reader that our findings are heavily dependent upon the calibration of the key parameters used within each model. The issues related to model calibration will be discussed in detail in a later section of this paper.

Discounting Methods

In our opinion, there are currently a number of well-defined approaches to discount loss reserves for the time value of money. The CAS proposal required only one approach to selecting the risk-free interest rate(s) to apply to the estimated payment pattern and future cash flows, but we decided to test the results using both a duration-based approach and a yield curve approach.

In general, we found there to be no significant differences in the results in terms of the impacts on a company's balance sheet or income statement under the two different approaches. We caution, however, that any time period of severe interest rate fluctuations and/or changes in the shape of the yield curve over time may indeed cause the results under these two approaches to diverge. We did not, however, observe this in the historical time period we studied (1998-2002).

MVM Methods

There are a variety of approaches available to calculate the MVM, with no single approach currently being universally preferred. The CAS White Paper on Fair Valuing Property/Casualty Insurance Liabilities (CAS, 2) contains thorough descriptions of many of the approaches available. We examined four different models to calculate the MVM and they will be discussed in more detail later in this paper. We applied the four models to the various sets of data in a manner so as to be responsive to the data as presented. We tried to minimize the degree of professional judgment in reacting to specific results for a particular company, line, or accident year, in this research, to allow the CAS and the reader to gain an appreciation for the practical issues that may emerge from applying such models to real data sets.

Our main findings after studying these four models include:

- For a given company and a given year-end, the MVM calculated by the four different models varied, sometimes significantly.
- For a given company and a given MVM model, the MVM varied over the time period studied, sometimes significantly.

- For a given company, the MVM calculated under each of the four different models over the time period studied did not always move in parallel (i.e. one MVM model did not always result in the highest MVM over time, etc.), adding further uncertainty and variation in the results.
- For smaller companies, the MVM tended to be larger (measured as a percentage of the loss reserves).

While these observations suggest a degree of volatility in the results generated by an MVM model applied to particular sets of data, we note that traditional actuarial methods for estimating ultimate losses and the associated reserves can also generate a dispersion of estimates. A degree of actuarial judgment is commonly applied in the application of reserving methods, and likewise, we would expect that judgment would be appropriate in the application of methods that evaluate the MVM component of fair value reserves.

Balance Sheet (Loss Reserves)

Our main findings regarding the potential impact of fair value accounting for the loss reserve component of a company's balance sheet are the following:

- For personal auto liability, based on the model calibrations in our testing, and based on interest rates prevailing during the experience period in our testing, the estimated fair value reserves (i.e. reserves after applying the discounting and MVM amounts) were generally greater than U.S. GAAP reserves.
- For workers' compensation, the estimated fair value reserves were generally less than or close to the U.S. GAAP reserves.
- For medical malpractice claims-made, we are unable to provide any credible findings, due to the approach taken of strictly applying the methods to the data, which were less credible than for the other two lines.
- When comparing across companies, there was greater variability of the fair value loss reserves around the actuarial best estimate for long-tail lines of business than short tail lines.
- The impact of moving to a fair value loss reserve tended to be greater for smaller companies, largely due to greater volatility in the loss reserves leading to a higher MVM requirement (on a percentage basis) than for larger companies.
- Any changing shape of the yield curve will impact the amount of reserve discounting. The period we analyzed (1998-2002) was generally a period of low interest rates. If the analysis was re-performed in a period of higher interest rates then our findings above could change as the impact of discounting would be more significant.

As a reminder, we did not consider the associated impact fair value accounting would have on any asset or other liability values.

Income Statement (Incurred Losses)

We evaluated the potential impacts of fair value loss reserves on a company's income statement. Our main findings are the following:

- In general, fair value incurred losses from the current accident year were greater than the U.S. GAAP current accident year incurred losses. Higher fair value current accident year incurred losses implies a deferred recognition of any profits.
- On a fair value basis, the contribution to calendar year incurred losses from prior accident years is not necessarily benchmarked to zero. By this we mean that under U.S. GAAP, there is no impact on future calendar year results if prior year undiscounted loss reserve estimates were perfectly estimated.

Under fair value, a company can generate a non-zero impact on future calendar year results even if the undiscounted loss reserve estimate does not change. The amount of the impact would be based on the relative changes to the amounts of the discount and the MVM. These fair value adjustments will tend to vary by company, line of business, accident year, and over time.

We note the leveraged impact that reserve changes have on the income statement, and thus even minor reserve swings that are due solely to changes in the discount and/or MVM amounts may generate significant impacts in the income statement.

Significant Issues

We identified the following areas as having significant issues in terms of practical application of the various methods and techniques utilized in evaluating fair value reserves.

Discounting and MVM Modeling Issues

- Estimated loss payment patterns
  - Estimating reasonable loss reserve payment patterns can be difficult with incomplete historical paid triangles, changes in the mix of business, significant growth or reductions in business levels, etc.
  - Professional judgment and relevant benchmark patterns may be required for evaluating reasonable patterns when the strict data contain apparent reversals in the payment pattern or unusual data points.
- Measures of loss reserve variation
  - For our analysis we accepted the booked reserves as the mean of the loss reserve distribution; in practice, this may not be the case. This assumption had an impact on the evaluation of expected payment and reporting patterns, and thus indirectly had an impact on the measure of variability of the actual historical loss experience in relation to expected amounts.
  - Variation associated with loss reserves from accident periods beyond the oldest period in the loss development triangle (i.e., Schedule P loss reserve amounts for the all prior accident years bucket), may be difficult to estimate and incorporate into some MVM models.
  - Certain property/casualty loss reserves (e.g. asbestos & environmental loss reserves) are not amenable to traditional statistical analysis, and therefore evaluating MVM's for such liabilities may be particularly challenging.

MVM Estimation Issues

- A single industry guideline for the calculation of the MVM is probably not reasonable for all companies, as variations by company may be meaningful and relevant depending on company size, types of business written, etc. For example, in our opinion, using historical industry payment experience to measure reserve variability would likely lead to an understatement of the variability of reserves as compared to evaluating company specific payment experience. As such, standards setters should consider if flexible guidelines that allow for reflection of individual company attributes should be issued.
- The actuarial and/or accounting literature may need to contain guidance on what are acceptable methods and calibration procedures for calculating MVM's in order to gain consistency in practice across the industry.
- The calibration of MVM models, which is discussed in more detail later in this paper, can be a challenging process and significantly affects the results. Standard setters and practitioners should consider the basis and frequency of calibration (e.g., performed on a quarterly, annual, or other basis).

Financial Statement Presentation Issues

We offer the following observations regarding the presentation of fair value reserves in a company's financial statements, including the notes to financial statements:

- Presenting fair value calendar year incurred losses split by current accident year and all prior accident year amounts may cause significant challenges. MVM's are statistically non-additive in nature, so any financial statement presentation that separates current and prior accident years will probably require allocation judgments across different accident years to be made.

  Further, the level of disclosure for the impact of prior accident year development on the calendar year incurred losses can influence the usefulness of the information to the financial statement reader. This important area highlights the significant disclosure issues surrounding the presentation of fair value insurance liabilities in the financial statements. If comprehensive, detailed disclosures are required, the disclosures might include the impacts from:

  - Changes in undiscounted (mean) loss reserve best estimate in comparison to the recorded loss reserve
  - The natural unwinding of the discount amount
  - The natural unwinding of the MVM as payments are made
  - Changes in effective interest rate
  - Changes in payout pattern
  - Changes in the measure of MVM variation
  - Changes in the MVM model calibration

While most of these items might be useful to the financial statement reader, some are not currently disclosed and would likely meet resistance from companies if required in the future (e.g., discussion of the changes in the relationship of the undiscounted best estimate underlying the fair value reserve to the undiscounted mean value of the distribution). It is also questionable as to how useful these disclosures might be due to their complexity and the number of items involved.

Data

In this section, we describe the various data that were used in our testing. As noted in the Scope & Objectives section, all data were from publicly available sources. We relied upon the data as presented in the sources. In actual practice, a company may have other compilations of data that might be used for evaluating fair value reserves.

Interest Rates

We used U.S. Treasury security yields at each year-end over the period we reviewed (1998 to 2002), with maturities ranging from 6 months to 30 years. These risk-free yields were not seasonally adjusted.

Loss Data

We utilized published U.S. Statutory Schedule P data as our source for historical loss development triangles. This complied with the data limitations specified by the CAS and identified in the Scope & Objectives section above. Schedule P data is on a U.S. Statutory basis and is net of reinsurance, but for simplicity we considered this data to be equivalent to data presented on a U.S. GAAP basis and will refer to it as such throughout this paper.

We also assumed that all loss reserves are undiscounted, and as such we did not make any adjustments to loss reserves for tabular and non-tabular discounting (e.g. as might be present in Schedule P for workers' compensation business). We did not consider this simplifying assumption to have a material impact on our findings.

Experience Period

We performed our analysis on data valued at year-ends 1998 to 2002 inclusive, providing information for five year-end balance sheet dates and four calendar year income statements. For each company in our study, we analyzed the ten accident years of development data reported in Schedule P of the Annual Statement as at each year-end from year-end 1998 to 2002 inclusive.

Companies & Lines of Business

We performed our analysis for ten selected companies for each of the three lines of business considered. Our selected companies included a mixture of those writing all three lines of business (i.e. multi-line writers) and those writing only one of the three selected lines. The ten companies selected for each line of business included:

- two large companies,
- two medium companies,
- three small companies, and
- three multi-line writers with sufficient volume for all three lines in the study.

The criteria for large, medium, and small by line of business are shown in the Appendix.

We selected this range to incorporate a cross-section of companies by size. The companies selected for each line represented the following proportions of the entire U.S. market, as measured by 2002 net earned premium, shown in Table 1:

Line of Business	Share of U.S. Market (2002 NEP)
Personal Auto Liability	15%
Workers' Compensation	17%
Medical Malpractice Claims-Made	23%

Table 1: Share of 2002 insurance market represented by our sample of ten companies for each line of business.

Methodology

In this section, we describe the approaches taken to calculate the fair value of the insurance loss reserves for the companies, lines, and valuation dates in our study. We also describe a variety of assumptions and limitations in applying the various models to the data. The analyses performed and conclusions reached are covered in other sections.

Our approach to calculating fair value reserves was to take undiscounted loss reserves (i.e. U.S. GAAP reserves), subtract an amount from these reserves to allow for discounting for the time value of money, and add a margin (MVM) to account for the risk and uncertainty in these reserves.

Discounting

We have reflected the time value of money in our fair value accounting scenarios using a risk free interest rate for loss reserve discounting based on US Treasury securities and the associated yield curve at each year-end valuation date. We assumed that cash payments occurred mid-year. We investigated the following two approaches to calculating the level of discount for the time value of money to see if there would be a discernable difference in results:

- Apply a risk-free interest rate that is associated with the duration of the projected future cash flow of the liabilities (i.e., duration approach);
- Apply a schedule of risk-free interest rates matching the projected future cash flows (i.e. yield curve approach) for each future period.

Our selected claim payment patterns were based on those implied by the cumulative paid loss and booked ultimate losses by accident year. These patterns were systematically adjusted to ensure they proceeded to 100% in a monotonically increasing manner, and that non-zero payment amounts were made in each period.

We also applied a systematic approach to allocating the tail factor over the selected period that we assumed the business would ultimately take to pay out. We used a decay factor approach with a manually selected decay percentage from period to period. We assumed that the loss reserves would pay out within 12, 35 and 20 years for the personal auto liability, workers' compensation and medical malpractice claims-made lines of business, respectively. We did not believe these assumptions had a material impact on the findings of this study.

For the payout of reserves associated with all-prior accident years (that is, the accident years prior to the 9^{th} prior accident year), we assumed that the payout pattern would be similar to the aggregate pattern for accident years at six to ten years of development. For example, if 50% of the loss reserves held for accident years that were six to ten years developed were expected to be paid out within the next twelve months, we assumed that 50% of the loss reserves for the all prior accident years would be paid out within the next twelve months.

MVM Methods

We used three different methods for calculating the MVM that resulted in four different models:

1. Return on Capital method
2. Development method with standard deviation approach
3. Stochastic simulation method with standard deviation approach
4. Stochastic simulation method with percentile approach

A brief explanation of the four models is given below and further details are contained in the Appendix.

Return on Capital (ROC) Method

This method assumes that a buyer of a set of insurance loss reserves would require a specified return on capital to undertake the risks involved with assuming the loss liabilities. With this method, the MVM is set so that a specified return on capital is achieved.

The ROC method requires the following assumptions:

- **Capital levels** – we assumed a solvency margin (e.g., capital) requirement equal to two times the U.S. risk-based capital (RBC) company action level by line of business. We assumed that the MVM amount forms part of the reserves on which this solvency margin is calculated.
- **Required return on capital** – we selected a constant annual required rate of return of 10% for the period we reviewed.
- **Payment pattern** – we have described our process to evaluate payment patterns by line of business in the Discounting section above.
- **Tax rate** – we assumed a constant tax rate of 30%.

Development Method (DM)

This method is a formulaic, deterministic method, and makes no assumptions about the distribution of the variability in loss reserves. The algorithm is based on the work of Thomas Mack (Mack, 1993 (1), see Appendix for description) and it generates a measure of variability based on the historical development experience, both for each individual accident year analyzed and for all accident years combined.

Under this model we selected a multiple of the standard deviation to estimate the MVM. We derived the appropriate multiple based on the calibration process described later in this paper.

The Development Method required the following assumptions:

- **Payment pattern** – Our process to select payment patterns by line of business was described in the Discounting section above.
- **Standard deviation for oldest and all-prior accident years** – The Mack algorithm does not derive a measure of variability of loss reserves for the oldest distinct accident period (9^{th} prior accident year in this case), or for accident periods older than the 9^{th} prior period in the data set used (i.e., for the all-prior accident years). For this study, we assumed the standard deviations of loss reserve for the 9^{th} prior accident year and the all-prior accident years were equal to the average of the selected standard deviation of the 7^{th} and 8^{th} prior accident years.

- **Selected standard deviation** – We applied the Mack algorithm to both the paid and reported loss development data to give two indicators for the variability of the ultimate loss estimate for each accident year. We selected the average of the two indications as the standard deviation of the reserves distribution.
- **Timing variability allowance** – We incorporated an allowance for variability in loss reserve payment timing, which the Mack algorithm does not specifically address. The allowance was based on adjusting the cumulative payment pattern factors by a multiple of the standard deviation of claim payment factors observed at each age. This multiple was the same as that derived in the calibration process.

Stochastic Simulation (SS) Models

The stochastic simulation (SS) method analyzes the variability in historical actual to expected claim payments for all ten accident years combined. We derived expected claim payments using the historical loss payment pattern implied by the current payment position and the recorded reserves. We then fitted a lognormal distribution to the variability in actual versus expected claim payments, and performed a simulation exercise to estimate the loss reserve distribution and the associated statistics for standard deviation of the distribution and the percentiles of the reserve distribution.

Similar to the development method, we relied on a calibration procedure to determine the appropriate target standard deviation and reserve distribution percentile for each line and valuation date.

The SS method requires the following assumptions:

- **Payment pattern** – Our process to select payment patterns by line of business was described in the Discounting section above.
- **Tail factor** – Our measure of variability under this method involved comparing actual and expected loss payments. We evaluated the variability of the ratios of actual loss payments to expected loss payments, from the latest ten accident years included in Schedule P. We assumed that the variability in the tail of the loss reserve payment distribution would be reasonably modeled by the assessment of the variability of the latest ten years of actual to expected payments.

The combination of two discount factor approaches and four MVM models generated a total of eight measures of loss reserves on a fair value basis for a given company, line of business, and year-end. This is illustrated in Table 2 below:

	Discounting Method		
MVM Model	Duration	Yield Curve Matched	**Fair Value Measures**
Return on Capital	X	X	2
Development	X	X	2
Stochastic Simulation – Standard Deviation	X	X	2
Stochastic Simulation – Percentile	X	X	2
Total			**8**

Table 2: Measures of loss reserves on a fair value basis based on the different approaches to calculating the discount factor and MVM.

MVM Model Calibration

The DM and SS models generated measures of loss reserve variability (and thus measures of risk to include in the MVM estimates) by calculating either standard deviations (for the DM and SS methods) or percentile distributions (for the SS method). These models, however, by themselves can give no indication as to which standard deviation multiple (e.g. one standard deviation, two standard deviations) or which percentile of the reserve distribution (e.g. 75th percentile, 90th percentile) would be appropriate to quantify the risk that should be included in the MVM to estimate a market value liability.

As a result, we decided to calibrate the MVM models using the ROC model as a base. The ROC model has the advantage of selecting a MVM amount based on a benchmark – required return on capital -- that is familiar to the investment community. We then calibrated the other three models by selecting the number of standard deviations or the target percentile that generated an MVM for that particular model equal to the ROC model MVM at a given point in time.

Calibrating these models provides the benefit of achieving some level of consistency across the different MVM models, and in turn provides more meaningful comparisons between the results of the different MVM models. Even if a company only uses a single statistical method to calculate their MVM, they may still wish to test their method using a ROC approach as a benchmark to ensure their selected measure of variability over time appears reasonable.

One of the main issues with respect to calibration is how often to perform the calibration. If calibration is to be performed annually, or as frequently as reporting is required, then the DM and SS models cease to add value since by definition they will always provide the same MVM as the ROC method. One option could be to select long-term values for some of the assumptions in a manner akin to life assurance-type valuations. However, at any given year-end the assumptions may deviate from the expected financial and economic environment, reducing the value of such an approach.

We calibrated the DM and SS models to the results of the ROC method at year-end 2002. As such the calibration for our results is dependent on the low interest rate environment that prevailed at that time as well as the measures of variability in the 10-year paid and reported development triangles valued at year-end 2002, which are indirectly dependent on the level of booked reserves at year-end 2002.

We performed the calibration process for each of the three lines of business by selecting one large, one medium, and one small company from our sample. We selected an arithmetic average of the standard deviation multipliers and the target percentiles from the three companies by line of business to help prevent any one company from unduly affecting the calibration. Table 3 shows the standard deviation multiples and distribution percentiles used by line of business and model after our calibration exercise:

Line of Business	Development Method SD Multiple	Stochastic Simulation SD Multiple	Stochastic Simulation Percentile
Personal Auto Liability	1.2	2.0	90%
Workers' Compensation	1.0	1.5	92%
Medical Malpractice	1.5	2.3	95%

Table 3: Model calibration results showing the multiples of standard deviation, and percentile to be used for calculating the Market Value Margin.

The lower multiples for the DM model are largely a product of the distributional assumptions made. The SS method calculated only a variability measure for all accident years combined, whereas the DM also considered the variability of individual years. We believe that this contributes to the DM's higher measure of standard deviation and variability, and hence lead to lower multiples of the larger standard deviation in the above calibration.

Further, the evaluation of variation in the DM model considered the experience on both a paid and reported basis, while the SS model considered only the variation in historical payment patterns.

Analysis

In this section, we present a variety of comparative summary views of key results figures. Due to the extensive set of data and results, for up to 10 companies, 3 lines of business, and 5-year-end valuation dates, we utilized a collection of 2-dimensional cross-tabulations to display the results. We also utilized several graphic views to present the results in a visual manner. For the charts, the scale for the vertical axis (Y-axis) were generally set automatically, based on the range of values being shown. Thus, the reader should be mindful of differing scales among the charts. Within the views, in order to mask the identities of the companies included in our sample, we have assigned an alpha-code to each.

Discounting

In general, we found no significant differences in the level of indicated discount using a duration approach versus a yield curve approach. As an example, Table 4 shows the indicated discount percentages for personal auto liability at each year-end valuation date and by company:

Sum of Total Discount			Year				
Line	Co code	Interest Method	1998	1999	2000	2001	2002
Personal Auto Liability	D (L)	Duration	8.0%	10.4%	8.5%	4.5%	2.5%
		Matched	8.0%	10.6%	8.4%	5.9%	3.5%
	E (L)	Duration	5.8%	7.7%	6.9%	4.4%	2.3%
		Matched	5.8%	7.9%	6.7%	5.6%	3.2%
	C (M)	Duration	8.2%	10.0%	8.2%	4.3%	2.3%
		Matched	8.2%	10.2%	8.0%	5.6%	3.2%
	F (M)	Duration	7.2%	9.3%	7.9%	4.4%	2.5%
		Matched	7.2%	9.4%	7.8%	5.6%	3.4%
	G (M)	Duration	6.7%	9.3%	7.8%	3.9%	2.2%
		Matched	6.7%	9.5%	7.7%	5.0%	3.0%
	A (S)	Duration	7.5%	7.5%	6.9%	4.5%	0.7%
		Matched	7.5%	7.7%	6.7%	5.9%	0.7%
	B (S)	Duration	8.2%	10.0%	8.2%	4.6%	2.7%
		Matched	8.2%	10.2%	8.1%	5.9%	3.8%
	H (S)	Duration	7.3%	9.6%	7.8%	4.9%	2.8%
		Matched	7.3%	9.7%	7.6%	6.1%	3.8%
	I (S)	Duration	6.8%	7.7%	7.9%	3.7%	2.4%
		Matched	6.8%	7.9%	7.8%	4.9%	3.3%
	V (S)	Duration	4.4%	5.6%	5.5%	2.5%	1.6%
		Matched	4.4%	5.8%	5.3%	3.3%	2.1%

Table 4: Personal auto liability. Comparison of indicated discount factors at each year-end using a duration approach versus a yield curve approach for each of the ten personal auto liability companies in our sample. The company code suffixes S/M/L in parenthesis indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

We caution, however, that severe interest rate fluctuations and/or changes in the shape of the yield curve over time may cause the two methods to generate significantly different results, but we did not observe this in the historical time period in our study. This effect would be more significant at shorter durations and for year-ends when interest rates are low, as small absolute changes in interest rates would become more significant in percentage terms. As shown above, this is more pronounced at year-end 2002, a time of relatively low interest rates.

To simplify presentation, for the remainder of this paper the charts and exhibits show results based only on the duration approach.

Personal Auto Liability

Indicated Market Value Margins

We present our indicated MVM results using the following four charts separately for each line of business:

1. ***MVM by company at year-end 2002*** – This chart shows the range of indicated MVM percentages from the four MVM models (ROC, DM and the two SS models) for each of the ten companies (shown smallest company to largest company going left to right) at year-end 2002. By focusing on the MVM calculated from the ROC model for each company (as shown by the triangle on the chart), we were able to observe where the MVM from the ROC model sat within the range of indications obtained from the four models, and look for any trends that might exist across the different companies.
2. ***MVM by company*** – This chart shows the range of indicated MVM percentages for each company over the whole time period (1998 to 2002), but now for only one MVM model (we selected the DM). We also show the straight average for the ten companies at each time period. This presentation shows how the results for a selected MVM model may vary by company at different points in time.
3. ***MVM by model*** – This chart shows the range of indicated MVM percentages for each MVM model over the whole time period, but now focusing on only one company. The purpose of this display was to show the different results that the different MVM models may generate for a given company over time.
4. ***MVM by company size*** – This chart shows a scatter diagram of the indicated MVM percentages for the four MVM models over the five year period. Each point represents an indicated MVM percentage for a particular MVM model and year-end ranked by the company's loss reserves as a measure of size. There are fifty points shown – ten companies for five evaluation points. The purpose of this view was to evaluate if any trends existed in the MVM amounts by size.

The following charts and descriptions highlight our finding for the personal auto liability line of business. Worker's compensation and medical malpractice findings are discussed in the next sections.

1. MVM by company at year-end 2002

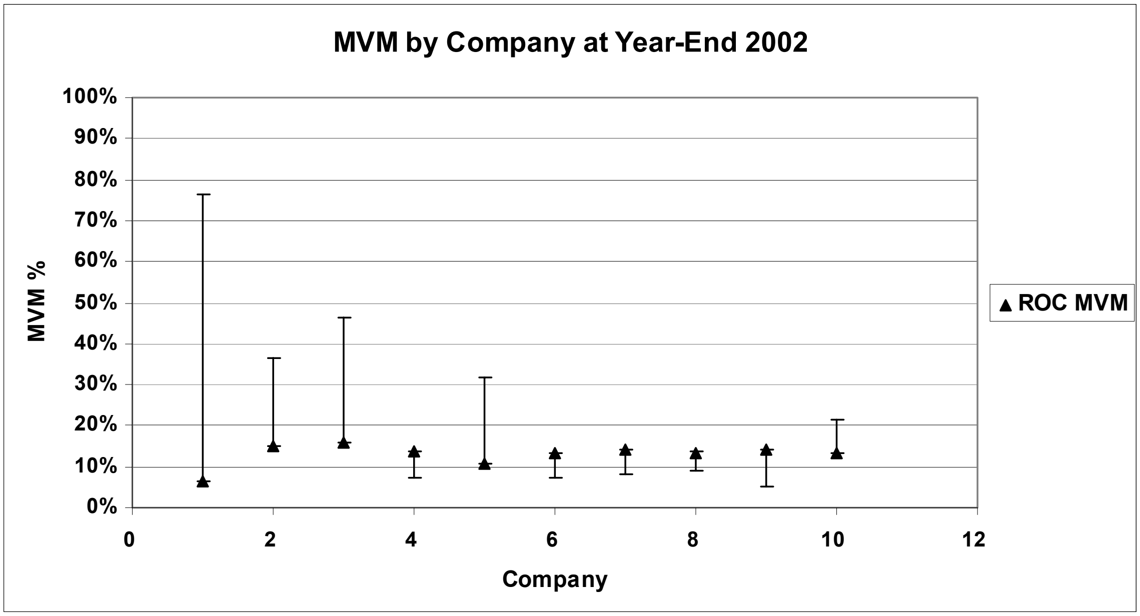


Chart 1: Personal auto liability. Range of indicated MVM percentages for the four models, by company, at year-end 2002. The companies are ordered from left to right by increasing size of company.

Chart 1 shows the four MVM models produced a relatively wide range of results by company at a given point in time. The dispersion tended to be wider for smaller companies. We note that for the other lines of business (workers' compensation and medical malpractice) the width of the range by company appeared to be less dependent on company-size but seemed to be generally wider for all companies. This will be shown later in this paper.

We also observe that within each range by company, the MVM calculated using the ROC model (our base model for calibration efforts) did not consistently sit within any particular part of the range (e.g. highest or lowest), as shown by the triangle marker by company.

2. MVM by company

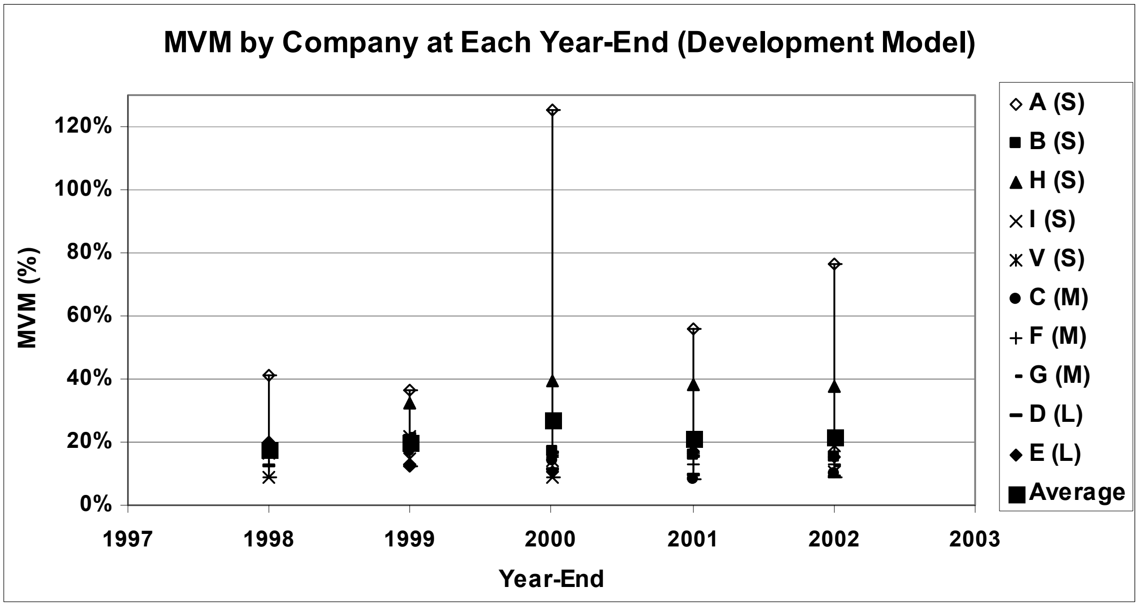


Chart 2: Personal auto liability. Range of indicated MVM percentages by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key to the right indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

Chart 2 shows, for the DM model, relatively significant swings by company over the time period. We remind the reader that our approach was to allow the specific company data to drive the results, with a minimum of judgmental intervention (primarily to avoid invalid calculations). This may have an impact on some of the results, especially for the smaller companies.

3. MVM by model

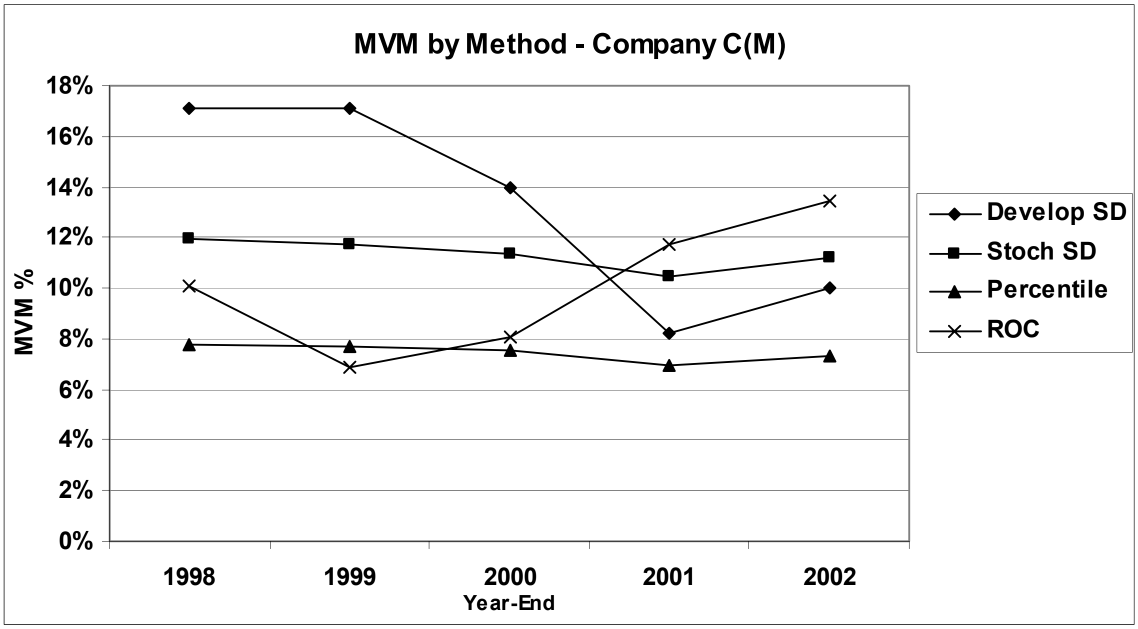


Chart 3: Personal auto liability. Indicated MVM percentages by model for a selected company by time period.

Chart 3 helps to compare the changes over the time period of the four different MVM models for a selected company. We observe that the results for any MVM model did not move in parallel over the time period (i.e., one model was not always the highest or lowest), and as such MVM amounts could be altered, perhaps significantly, by switching the MVM model at any given time.

4. MVM by company size

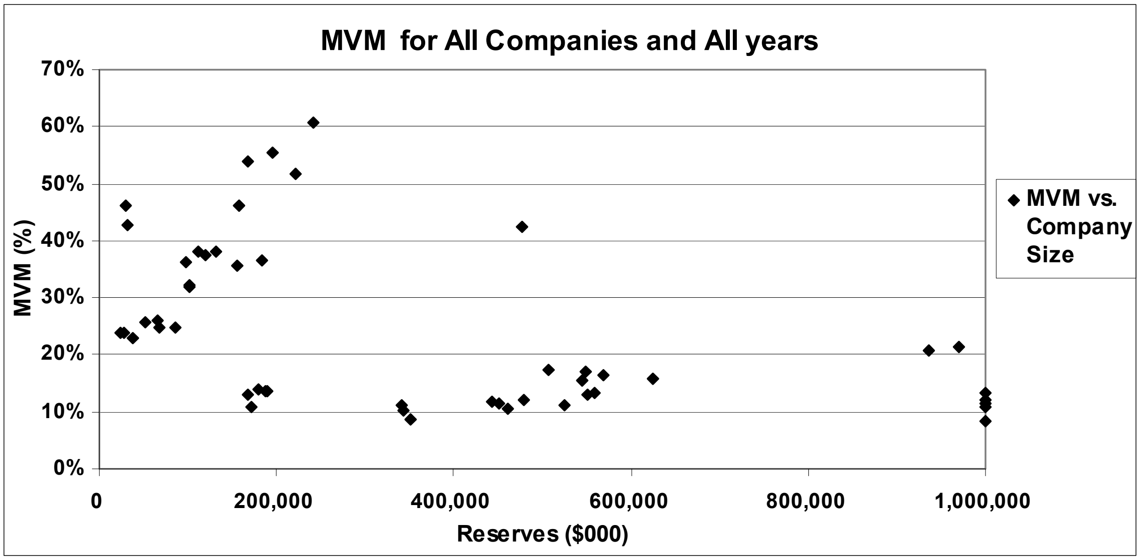


Chart 4: Personal auto liability. Indicated MVM percentages for all four models and all time periods plotted against company size (X-axis values above $1 billion were truncated to $1 billion).

Chart 4 highlights what appears to be an inverse relationship between company size and indicated MVM percentage (i.e. smaller companies typically require a higher MVM, as measured in percentage terms). This is not surprising, as one would expect the loss reserves for smaller companies to be inherently more volatile than those of larger companies. Stated another way, the MVM percentages for larger companies should be relatively smaller (in percentage terms) since the law of large numbers would suggest a reduction in the relative variation of the aggregate reserves for larger companies.

Indicated Fair Value Factors

We have shown the results for the discount percentage and the MVM percentage separately; we now combine them to determine the full impact for fair value reserving. We use the term Fair Value Factor (FVF) to equal the combined effect of the discount factor and the MVM factor.

$$\textit{Fair Value Factor} = [\,(1.00 - \textit{Discount}\,\%) \times (1.00 + \textit{MVM}\,\%)\,] - 1.00$$

$$\textit{Fair Value Reserves} = \textit{U.S. GAAP Reserves} \times (1.00 + \textit{Fair Value Factor})$$

We will show the same four types of charts for the FVF percentages as for the MVM percentages. In general, for personal auto liability, the relatively small impact of the discount factor meant that the FVF patterns and trends observed by company and model were similar to the MVM patterns and trends.

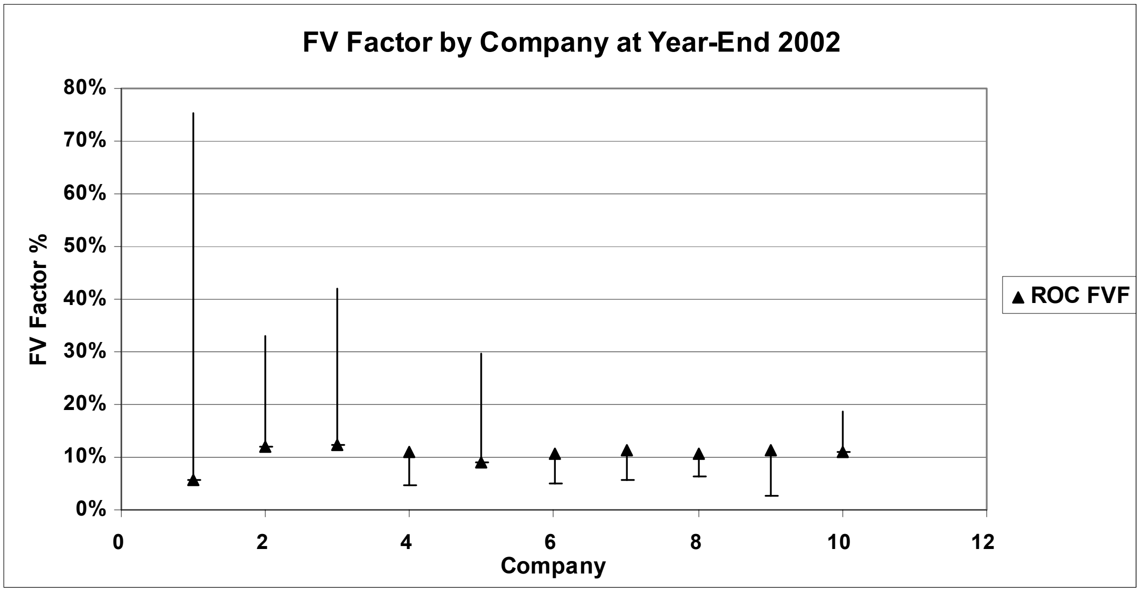


Chart 5: Personal auto liability. Range of indicated FVF percentages for each of the four models, by company, at year-end 2002. The companies are ordered from left to right by increasing size of company.

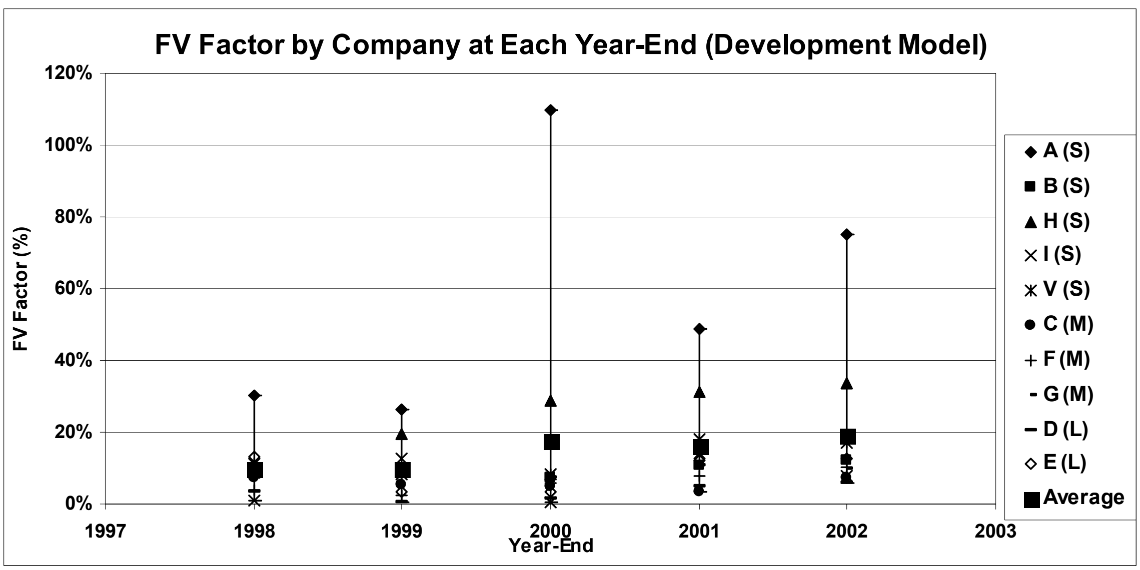


Chart 6: Personal auto liability. Range of indicated FVF percentages by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

Based on our testing, the results from the Development Model as shown in Chart 6 suggest that fair value loss reserves for personal auto liability could be 5% to 20% greater than on a U.S. GAAP basis.

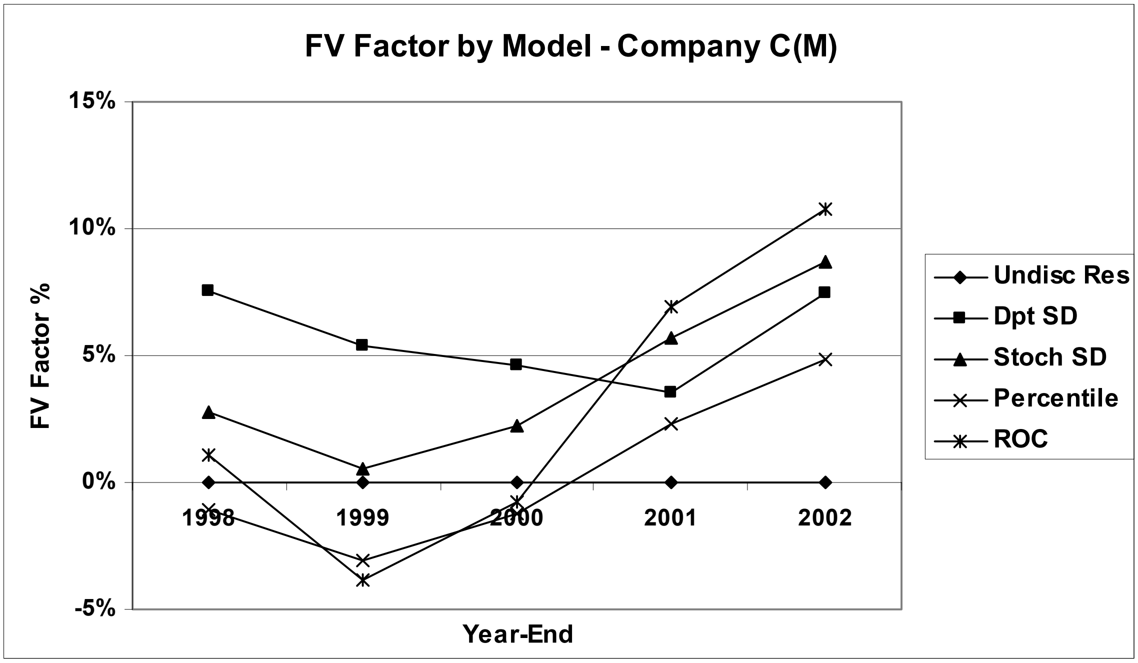


Chart 7: Personal auto liability. Indicated FVF percentages by model for a selected company by time period. We also include a data series at 0% for the undiscounted (U.S. GAAP) reserves.

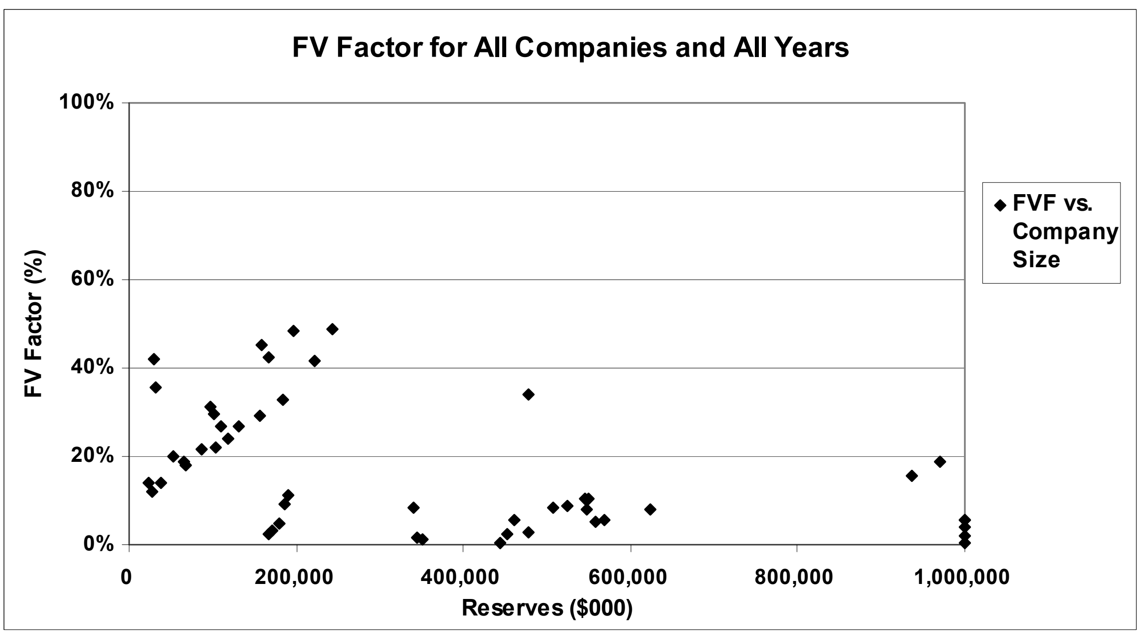


Chart 8: Personal auto liability. Indicated FVF percentages for all four models and all time periods plotted against company size. (X-axis values above $1 billion were truncated to $1 billion).

Impact on Calendar Year Incurred Losses

Calendar year incurred losses (CYIL) are expressed by the following:

CYIL = calendar year payments + (closing reserve - opening reserve)

The level of calendar year payments does not vary whether reporting on a U.S. GAAP basis or on a fair value basis, so any differences between U.S. GAAP and fair value in the CYIL emerge through differing reserve valuations at the opening and closing balance sheet dates.

We return now to our series of four charts that we used to present the indicated MVM and FVF percentages. Now, however, we focus on the differences in the CYIL on a fair value basis and a U.S. GAAP basis (shown as a percentage of net earned premium).

1. ***CYIL difference by company for calendar year 2002*** - Chart 9 shows the range of the difference in CYIL (fair value basis less U.S. GAAP basis) for the four models for calendar year 2002. This is shown for each of the ten companies ordered from left to right by increasing size of company. The difference for the ROC model is identified in the chart with a triangle tick-mark.

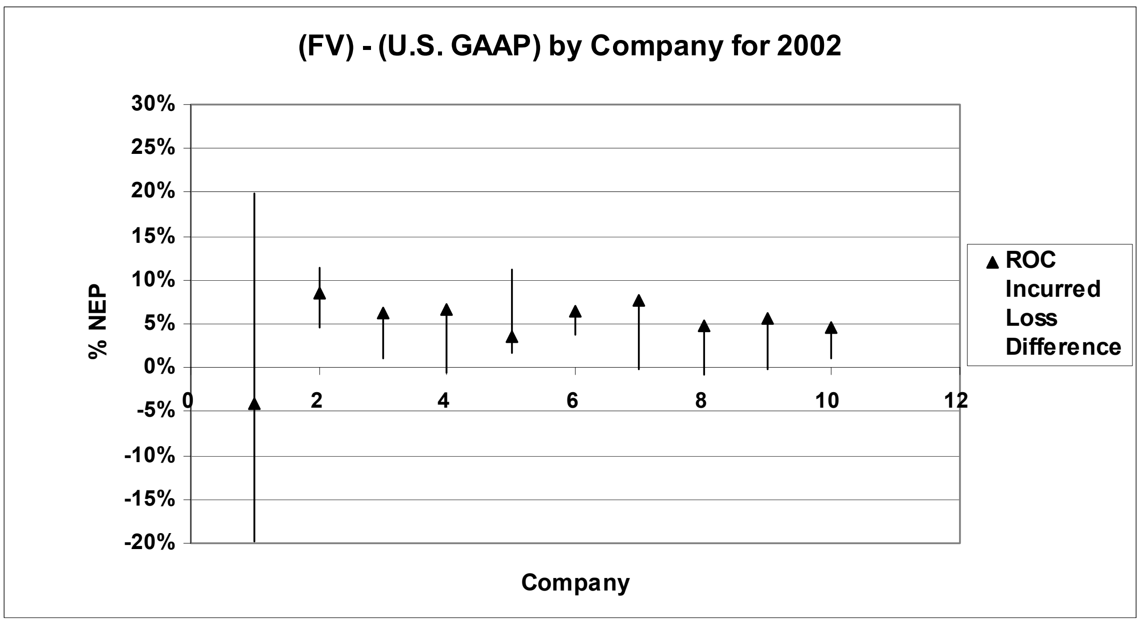


Chart 9: Personal auto liability. Range of the difference in CYIL (fair value basis less U.S. GAAP basis) for the four models, by company, for calendar year 2002. The companies are ordered from left to right by increasing size of the company.

In this view, it appears that the impact on the personal auto liability CYIL of going to a fair value basis was generally unfavorable but small (i.e. generally between 0% and 10% of net earned premiums) for calendar year 2002. These particular results are, in part, influenced by the decrease in interest rates from year-end 2001 to year-end 2002, with the reduction in discount amount recognized in the calendar year incurred losses. Results for the other lines of business (workers' compensation and medical malpractice) are much wider and will be shown later in this paper.

2. *CYIL difference by company* – Chart 10 shows the range of the difference in CYIL (fair value basis less U.S. GAAP basis) over the whole time period (1999-2002), but now for only one model (DM). The straight average for the ten companies at each time period is identified by the large square tick-mark.

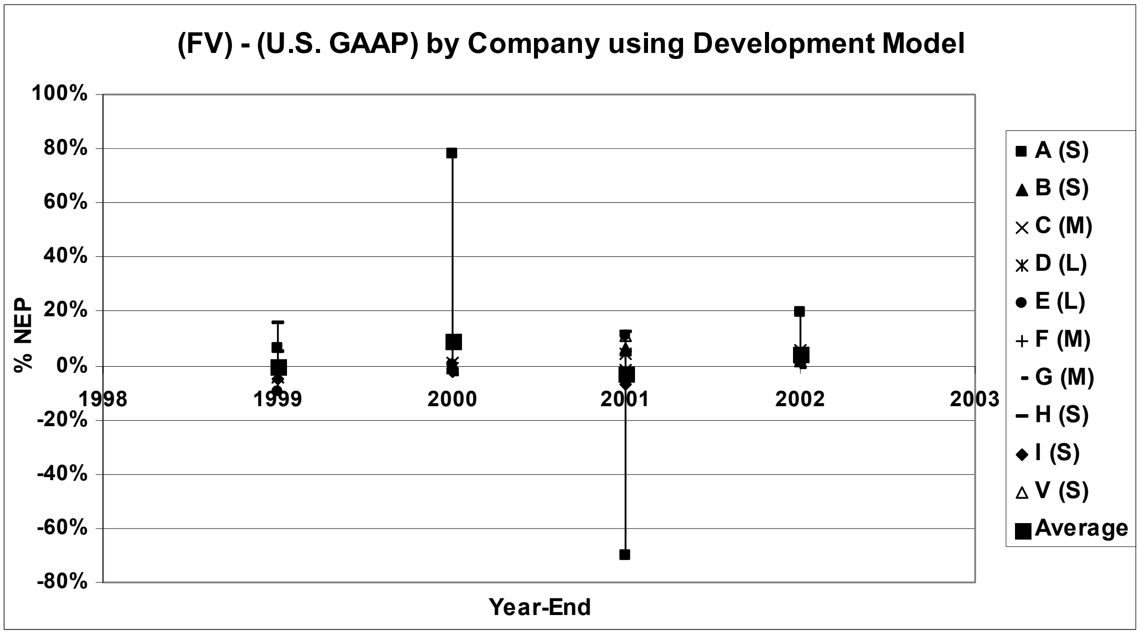


Chart 10: Personal auto liability. Range of the difference in CYIL (fair value basis less U.S. GAAP basis) by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

We note that the average CYIL impact (identified by the large square tick-mark) tended to move in a band of +/-10% for personal auto liability. Results for the other lines of business (workers' compensation and medical malpractice) are much wider and will be shown later in this paper.

3. ***CYIL impact by model*** – Chart 11 highlights the difference in the CYIL (fair value basis less U.S. GAAP basis) for each of the four MVM models over the whole time period, but now focusing on one selected medium-sized company.

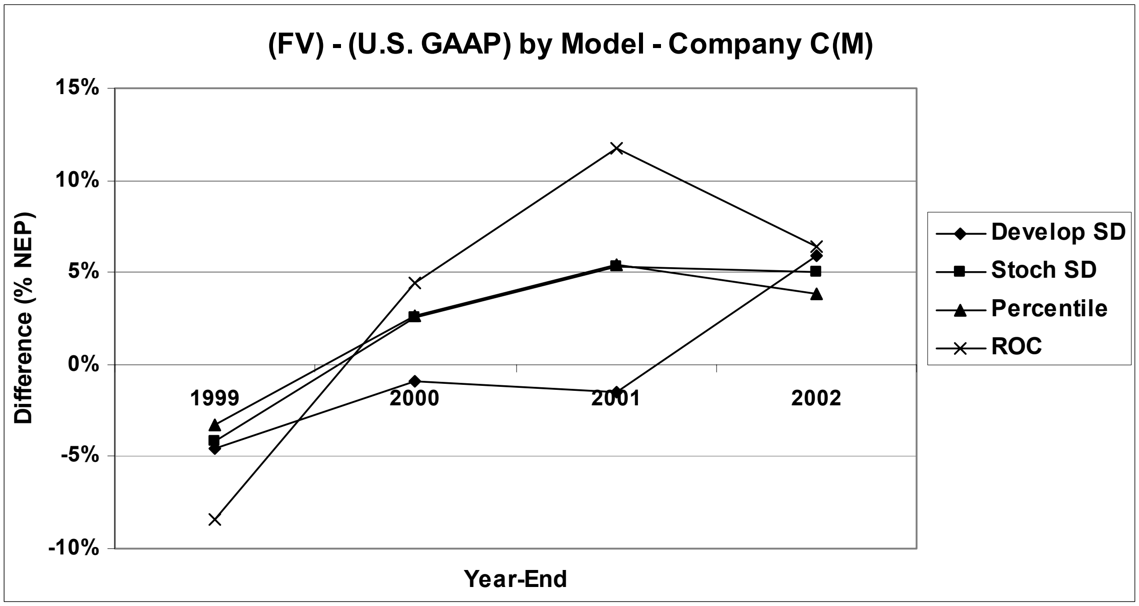


Chart 11: Personal auto liability. Difference in CYIL (fair value basis less U.S. GAAP basis) for a selected company by time period.

This chart shows a comparison of the results for the four different MVM models over time, and again the results for any MVM model do not always move in parallel over the time period. It is possible that the level of CYIL could be managed to a certain extent, possibly quite significantly, by switching calculation models at a given year-end.

4. *CYIL impact by company size* – Chart 12 shows a scatter diagram of the difference in the CYIL (fair value basis less U.S. GAAP basis) for the four MVM models over the four-year period. Each point represents a CYIL difference for a particular MVM model, time period, and company.

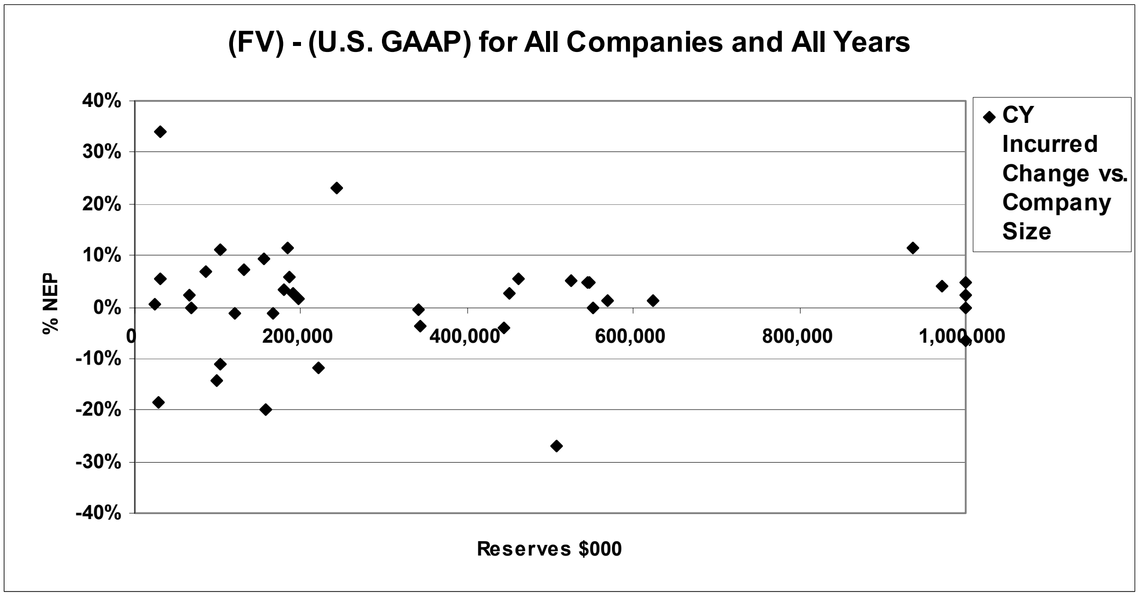


Chart 12: Personal auto liability. Difference in CYIL (fair value basis less U.S. GAAP basis) for all four models and all time periods plotted against company size (X-axis values above $1 billion were truncated to $1 billion).

Chart 12 shows an inverse relationship between company size and the variability of the CYIL impact (i.e. smaller companies typically saw more volatility in the CYIL impact, in terms of percentage of earned premium).

Impact by Accident Year

We also investigated the drivers of the impact fair value standards may have on CYIL by trying to split the CYIL impact into the current accident year versus development from prior accident years. We present this by first considering the change in the total CYIL (i.e. the combined impact of the current accident year and development from prior accident years), as shown below in Chart 13. For this series of charts, we used the results from the SS standard deviation model.

Current Accident Year

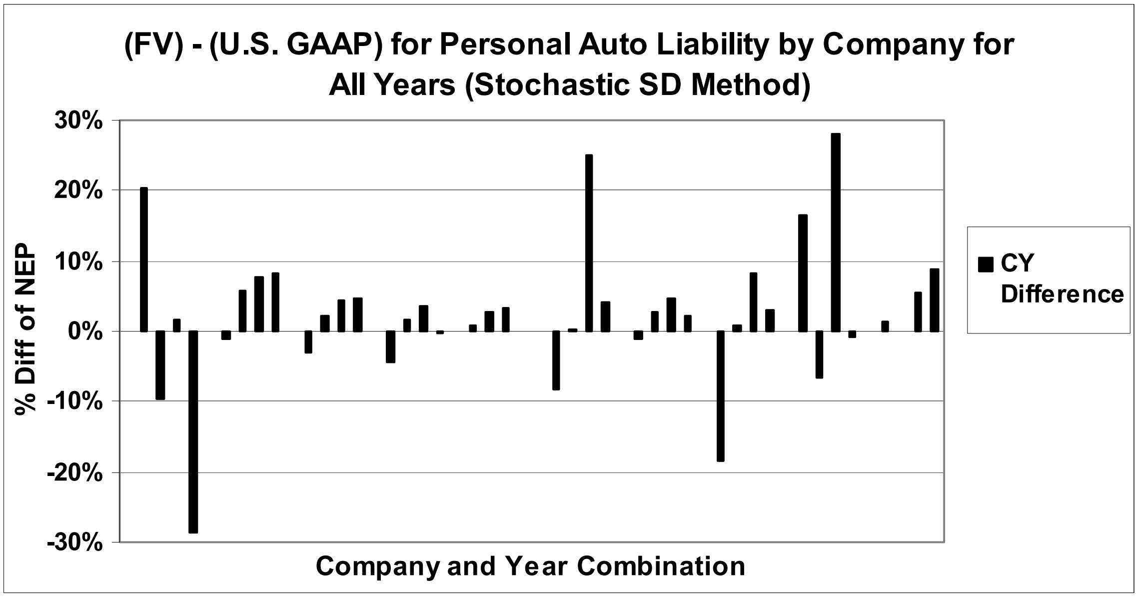


Chart 13: Personal auto liability. Difference in CYIL (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002).

As shown in Chart 14 below, we generally observed that current accident year incurred losses on a fair value basis were greater than on a U.S. GAAP basis.

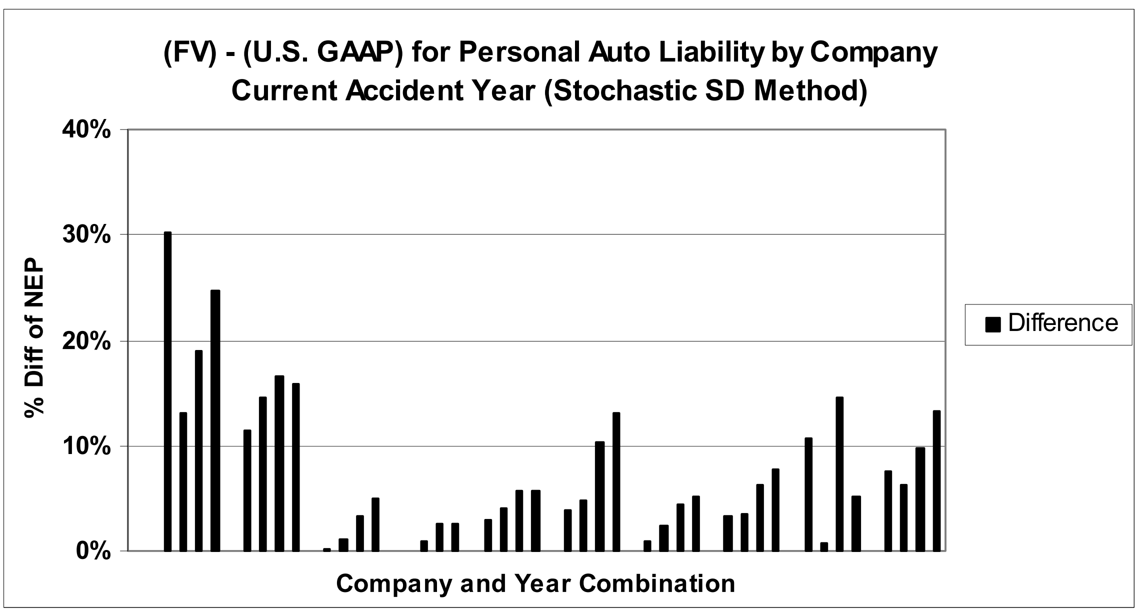


Chart 14: Personal auto liability. Difference in current accident year incurred losses (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002).

These results are influenced largely by the calibration of the MVM models used in our testing. For the current accident year, the MVM tended to more than offset the discount effect, so that fair value incurred losses for the current accident year were larger than on a U.S. GAAP basis.

One-Year Development of Prior Accident Years

We conducted further analysis on the impact the one-year development of the prior accident year incurred losses has on the CYIL (as shown below in Chart 15).

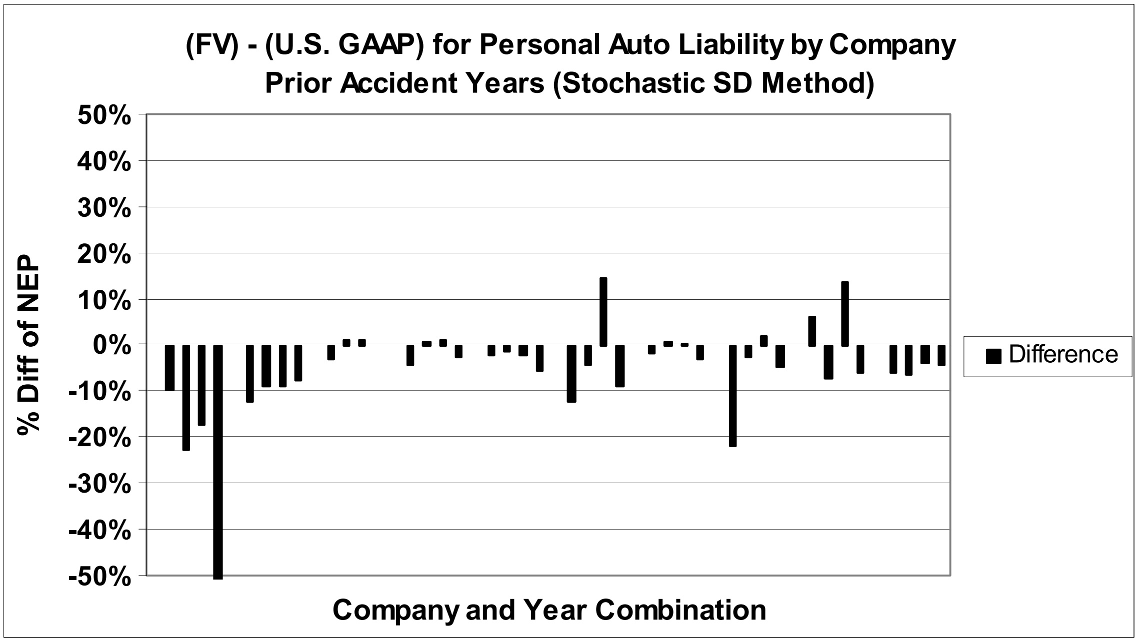


Chart 15: Personal auto liability. Impact of one-year development of prior accident years (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002).

We generally observed that, for personal auto liability, the CYIL impact from prior accident year development was less on a fair value basis than on a U.S. GAAP basis. This situation appeared to be more evident for personal auto liability than for workers' compensation or medical malpractice. This would appear to be logical if including the impact of the discount factor and MVM results in higher initial reserves (as it did with personal auto liability, Chart 14). As a result, the one-year development of prior year reserves would tend to lead to subsequent reserve releases for personal auto liability rather than subsequent reserve deterioration.

We performed further analysis on the personal auto liability results to study the underlying reasons why the reserves on a fair value basis developed more favorably than those on a U.S. GAAP basis. Over the four year period studied, the average one-year development observed on a fair value basis was an improvement of four percentage points (i.e. -4%), while the average one-year development observed on a U.S. GAAP basis was a deterioration of three percentage points (+3%). The major reason for the difference was a seven percentage point improvement attributable to the natural "unwinding" of the combined "loading" from the discount factor and the MVM percentage. The contributions made from actual changes to the discount rate and actual changes in the MVM percentage used at subsequent year-ends were relatively minor. We quantified the effects of four components to the fair value basis measurement of one-year development of prior years' reserves. The average amounts for these components for the companies in our sample for the four calendar years, and a variability measure (standard deviation) of each, are shown in Table 5 below:

	Fair Value	U.S. GAAP	Unwinding	FV change Discount %	FV change MVM %
Average	-4%	3%	-7%	1%	0%
Standard Deviation	12%	16%	9%	1%	3%

Table 5: Decomposition of Fair Value one-year development among the constituent components of that development.

These effects would, of course, vary by company and by time period and would likely be variable on a specific company basis. However, the above figures may be viewed as indicative and certainly provide some insight into the drivers of the one-year development. The observed deterioration due to discount rate changes were the result of decreases in average interest rates over the period examined, and could easily swing in the opposite direction if a different period of analysis were selected. Chart 16 illustrates the various elements of the 1-year development results:

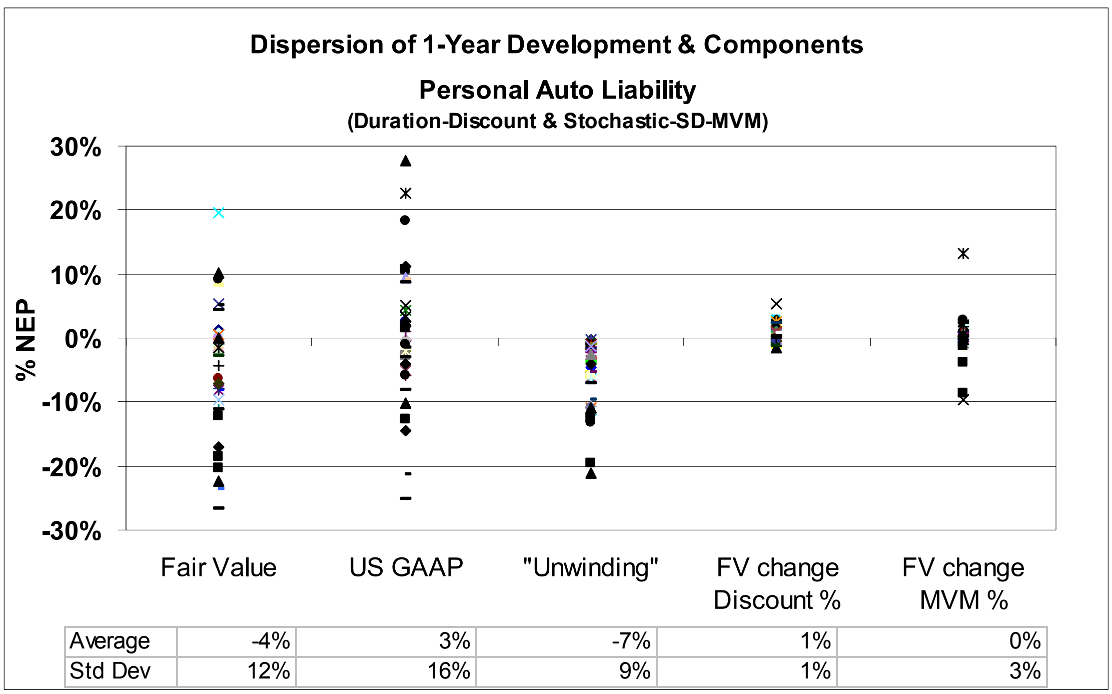


Chart 16: Decomposition of Fair Value one-year development among the constituent components of that development, with the associated variability of the component.

This further analysis also serves to highlight the critical issue of disclosure. Information regarding the components of one-year development could be presented to make financial statements more transparent and accessible to their users. However, such information is not necessarily straightforward to present in a concise format, and while intelligible to the actuarial community, may not be so to investors and analysts. As such we would question whether providing this information to increase disclosure would improve transparency and understanding to the majority of investors.

On a practical level, we were confronted with the issue of calculating the MVM for individual accident years, and indeed whether such values have any meaning. IASB publications (IASB, 3) indicate that the MVM should be calculated for homogeneous groups of business, and that correlation adjustments should not be made (guidance which would appear to encourage companies to aggregate business as much as possible for the purpose of calculating MVM factors). Because of the non-additive nature of the MVM across accident years, such subdivision is non-trivial. Entities would not want to calculate the values separately at very detailed levels because the non-additive property will lead to higher MVM's, yet such an approximation would be needed if current disclosures such as one-year development are to continue. In these cases, possibly an allocation could be developed, and the assumptions used to develop it could then be disclosed in the financial statements.

Workers' Compensation

In this section, we present the same sequence of charts as for Personal Auto Liability.

Indicated Market Value Margins

1. ***MVM by company at year-end 2002*** – Chart 17 shows that, similar to personal auto liability, for workers' compensation the four models produce a wide range of results by company at a given point in time, and in fact the range is wider. We observed that the MVM calculated using the ROC model, again, did not consistently sit within any particular part of the range. The range of results appeared less dependent on the size of company than for personal auto liability, but the range of model results for a given company tended to be larger.

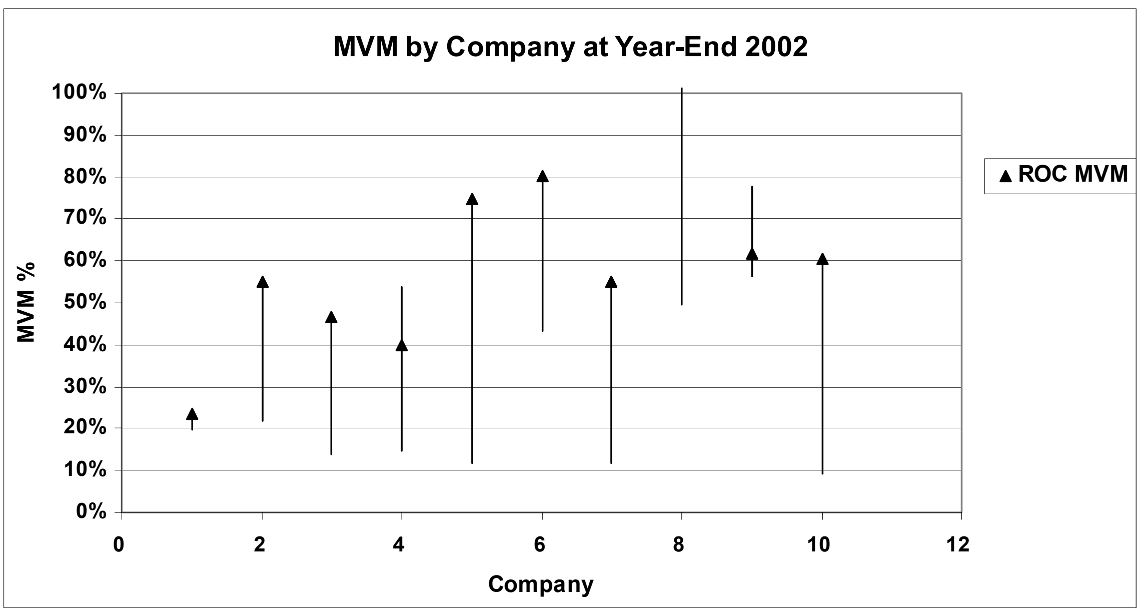


Chart 17: Workers' compensation. Range of indicated MVM percentages for the four models, by company, at year-end 2002. The companies are ordered from left to right by increasing size of company.

2. ***MVM by company*** – Chart 18 shows a wide range of results when focusing on one model (DM).

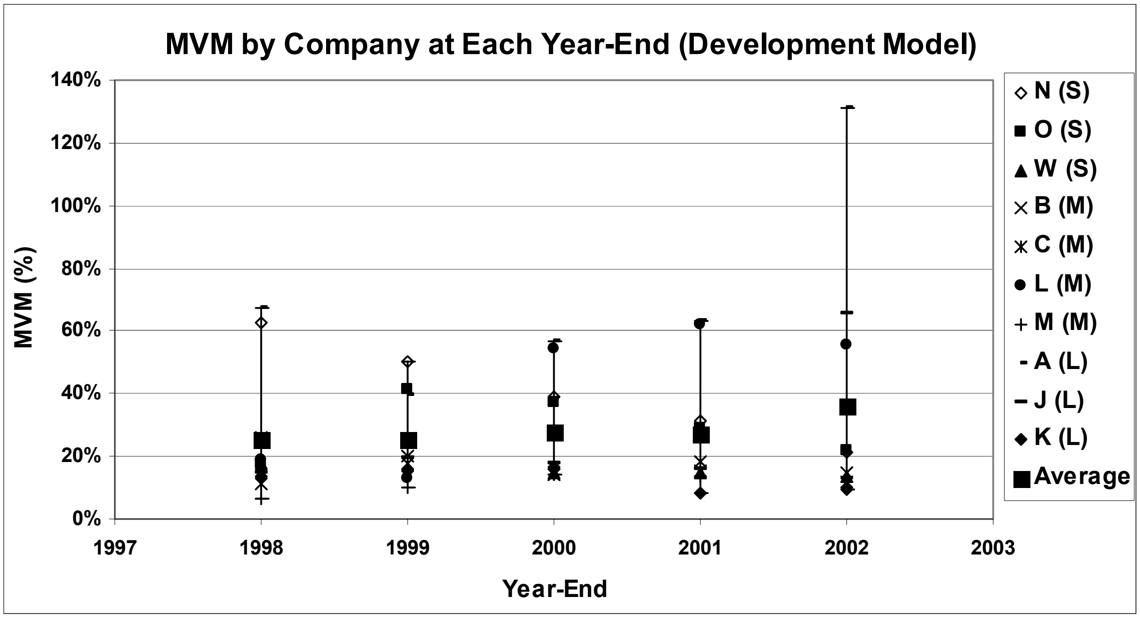


Chart 18: Workers' compensation. Range of indicated MVM percentages by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key to the right indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

3. ***MVM by model*** – Chart 19 shows the interaction of the four different MVM models for a selected company. The results again did not move in parallel over time, and as such MVM amounts could be altered, perhaps quite drastically, by switching calculation models at any given time. The trend in MVM from the ROC model is driven by the (opposite) trend in interest rates over the period.

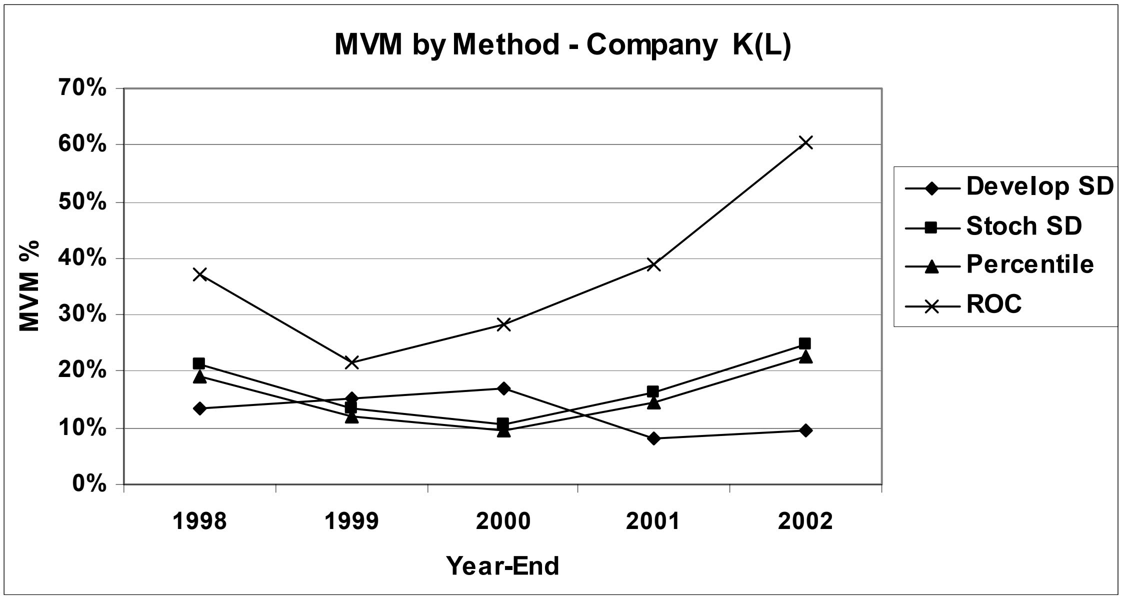


Chart 19: Workers' compensation. Indicated MVM percentages by model for a given selected company by time period.

4. ***MVM by company size*** – Similar to personal auto liability, Chart 20 highlights for workers' compensation what appears to be an inverse relationship between company size and MVM requirement (i.e. smaller companies typically require a higher MVM, as measured in percentage terms).

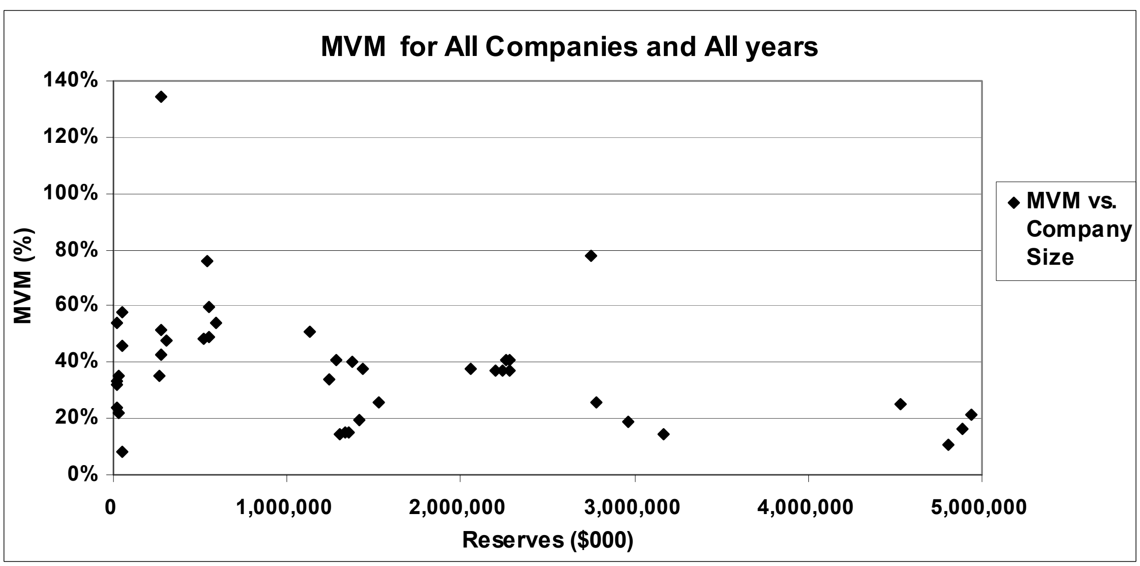


Chart 20: Workers' compensation. Indicated MVM percentages for all four models and all time periods plotted against company size.

Fair Value Factors

For workers' compensation, the discount element was much more significant than for personal auto liability, so many of the analyses showed the MVM being offset by the discount factor. Volatility of results across companies was much greater for this class of business, driven by a number of factors, including our prescriptive approach to the calculations across all companies in the sample. This is shown in the following charts:

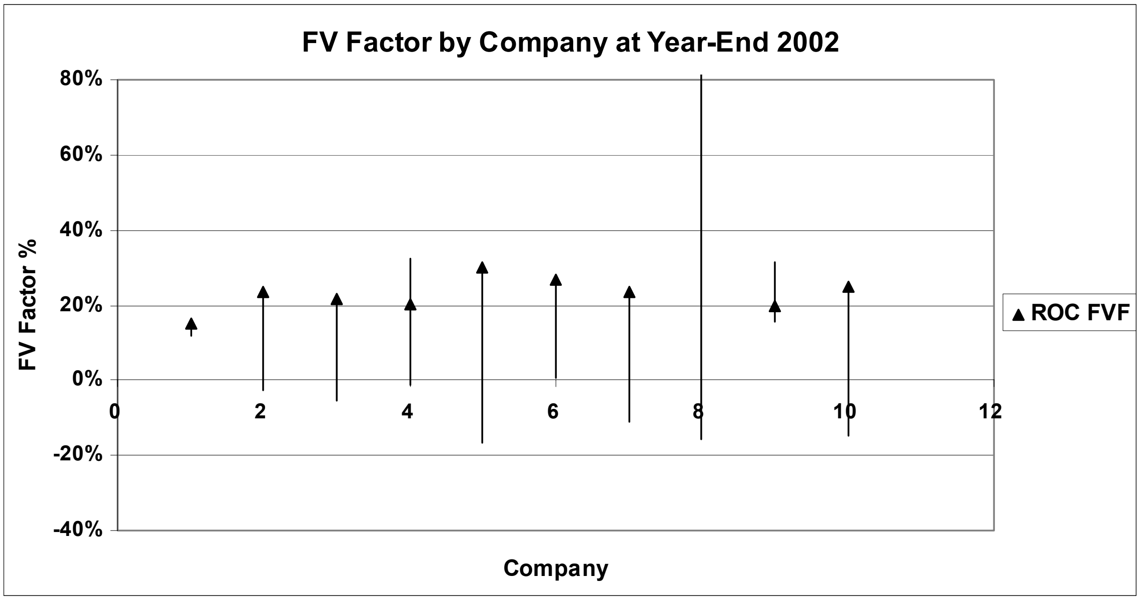


Chart 21: Workers' compensation. Range of indicated FVF percentages for each of the four models, by company, at year-end 2002. The companies are ordered from left to right by increasing size of company.

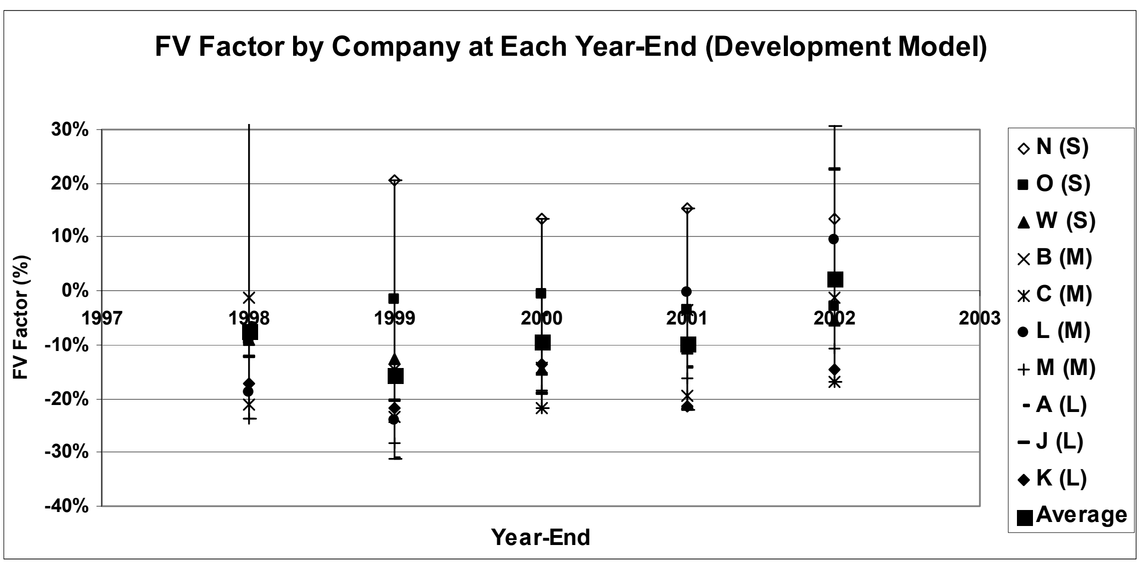


Chart 22: Workers' compensation. Range of indicated FVF percentages by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

Based on our testing, the results from the Development Model as shown in Chart 22 suggest that fair value loss reserves for workers' compensation could be 0% to 15% less than on a U.S. GAAP basis.

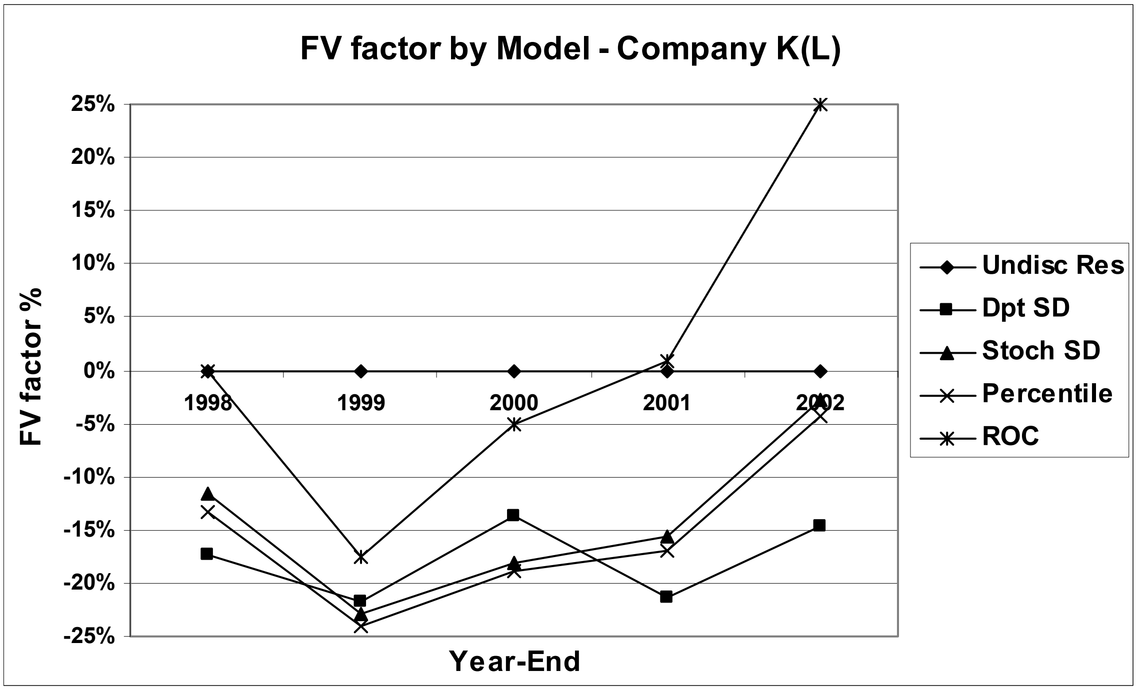


Chart 23: Workers' compensation. Indicated FVF percentages by model for a selected company by time period.

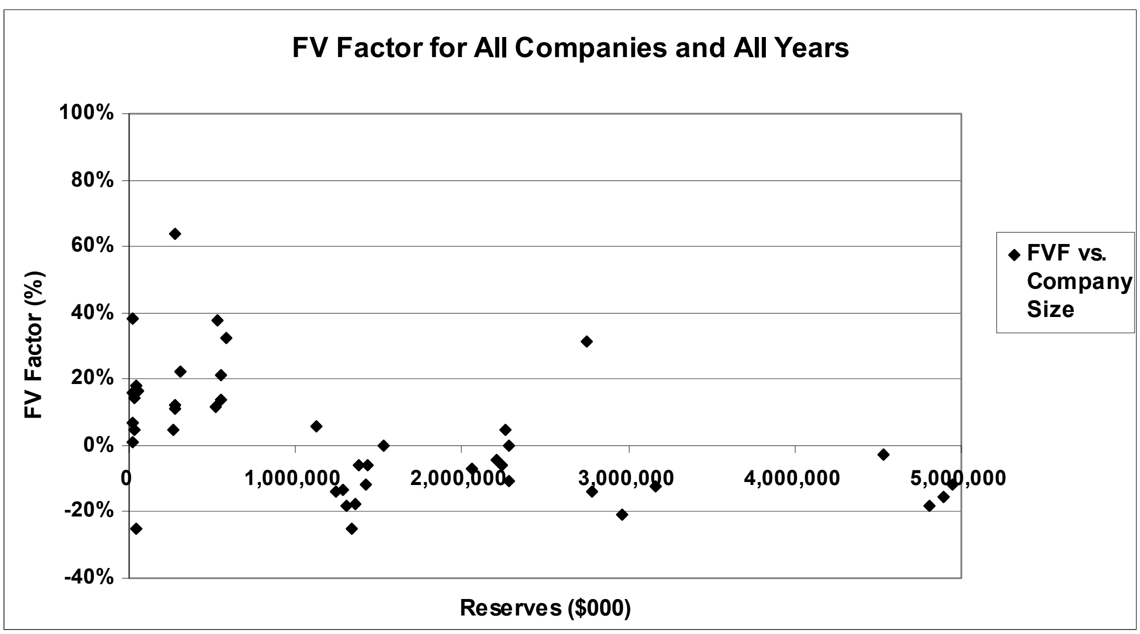


Chart 24: Workers' compensation. Indicated FVF percentages for all four models and all time periods plotted against company size.

Impact on Calendar Year Incurred Losses

1. ***CYIL difference by company for calendar year 2002*** – Chart 25 shows the range of the difference in CYIL (fair value basis less U.S. GAAP basis) for the four models for calendar year 2002.

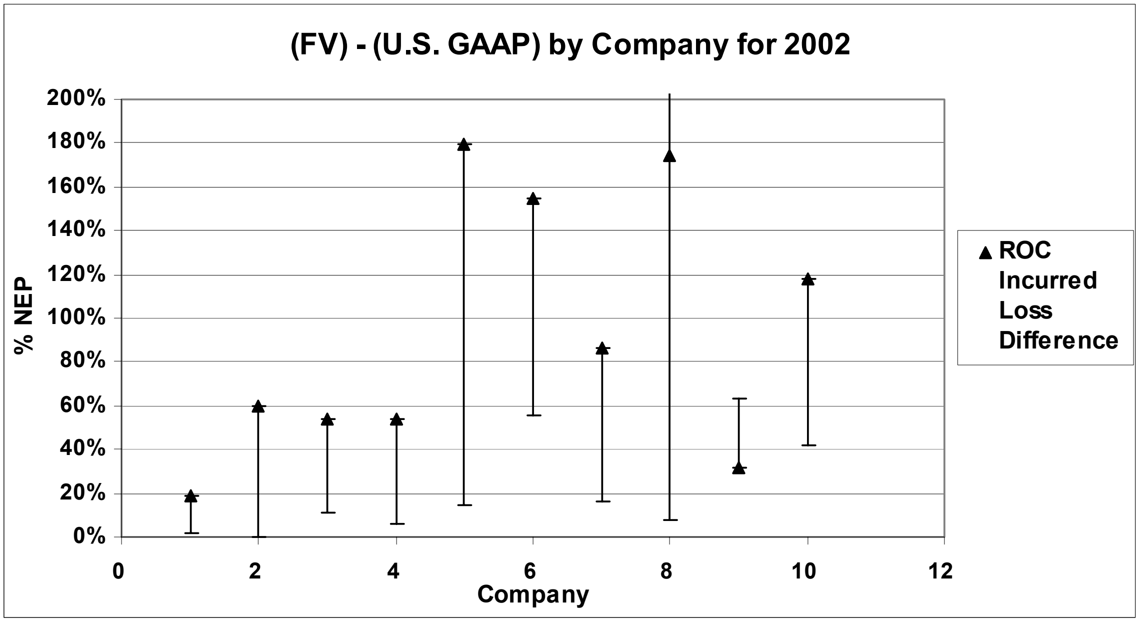


Chart 25: Workers' compensation. Range of the difference in CYIL (fair value basis less U.S. GAAP basis) for the four models, by company, for calendar year 2002. The companies are ordered from left to right by increasing size of the company.

The differences between CYIL on a fair value basis and a U.S. GAAP basis could be significant, depending on the extent of changes in opening and closing discount amounts, driven by changes in year-ending interest rates. Additionally, changes in the MVM percentages would contribute to the impacts. The particular results shown in Chart 25 reflect a decrease in interest rates from year-end 2001 to year-end 2002.

2. ***CYIL difference by company*** – Chart 26 shows the range of the difference in CYIL over the whole time period (1999-2002) for one model (DM). We note that the average CYIL impact within the group of companies (as shown by the large square tick-mark) tended to be less stable over time than for the personal auto liability line of business. The automatic scale for the Y-axis is influenced by the result for one company for 1999.

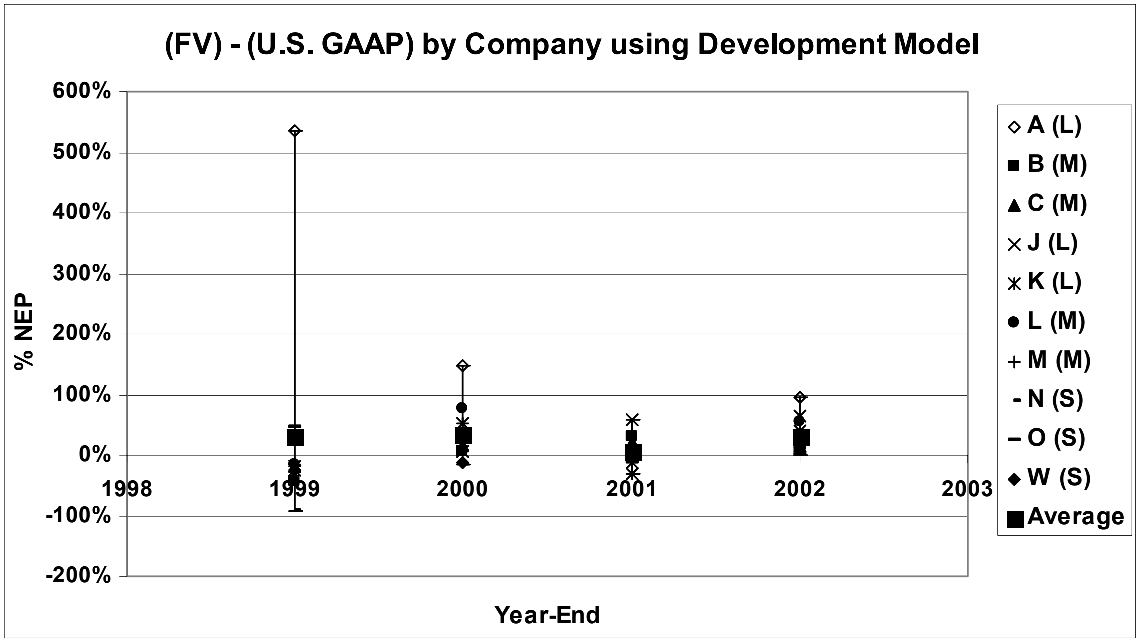


Chart 26: Workers' compensation. Range of the difference in CYIL (fair value basis less U.S. GAAP basis) by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

3. ***CYIL impact by model*** – Chart 27 highlights the difference in the CYIL (fair value basis less U.S. GAAP basis) for each of the four MVM models over the whole time period, but focusing on one selected (large) company. The results by model again did not always move in parallel over time.

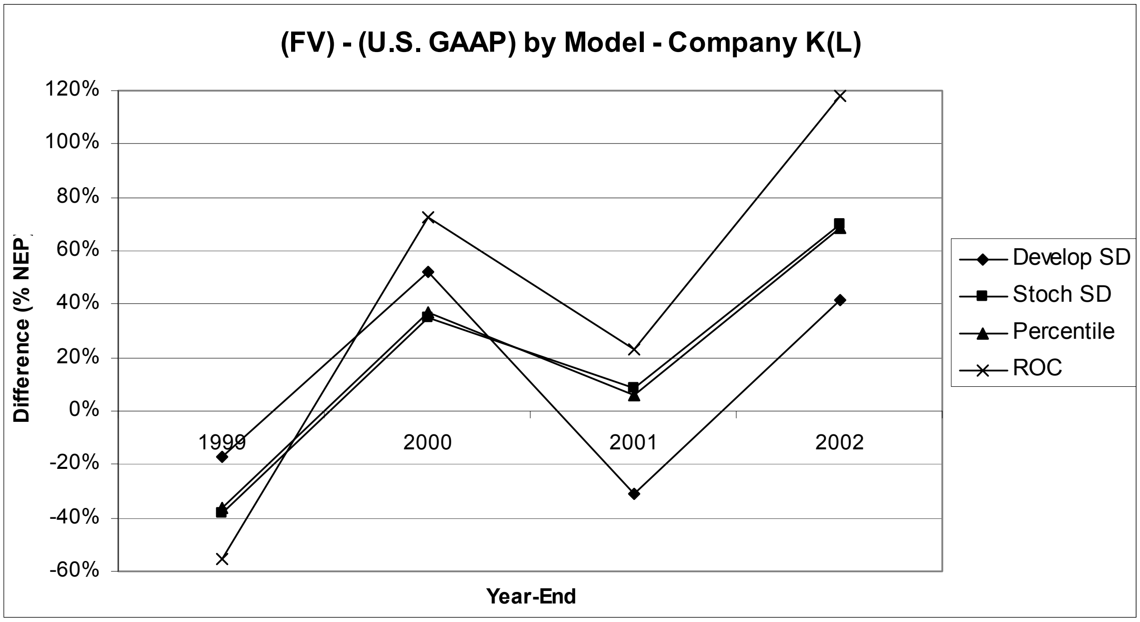


Chart 27: Workers' compensation. Difference in CYIL (fair value basis less U.S. GAAP basis) for a selected company by time period.

The impacts on CYIL can be significant, due to changing interest rates and the leveraged effect based on the ratio of a company's reserves to annual incurred losses.

4. *CYIL impact by company size* – Chart 28 shows a scatter diagram of the difference in the CYIL (fair value basis less U.S. GAAP basis) for the four MVM models over the four year period.

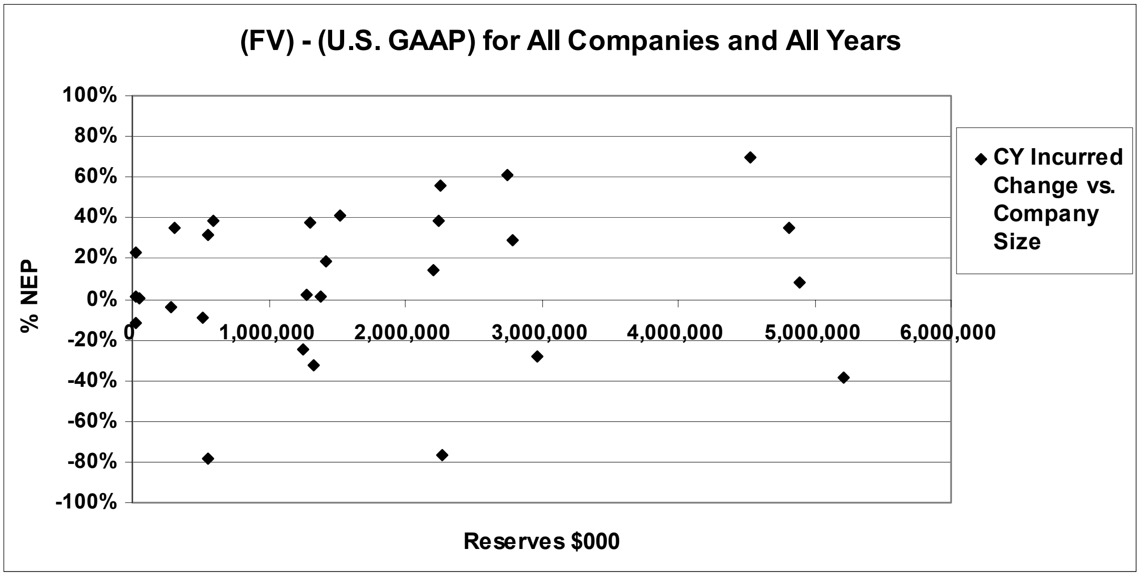


Chart 28: Workers' compensation. Difference in CYIL (fair value basis less U.S. GAAP basis) for all four models and all time periods plotted against company size.

Impact by Accident Year

Chart 29 shows the change in the total CYIL (for all accident years) for one model, for the selected companies over the four years.

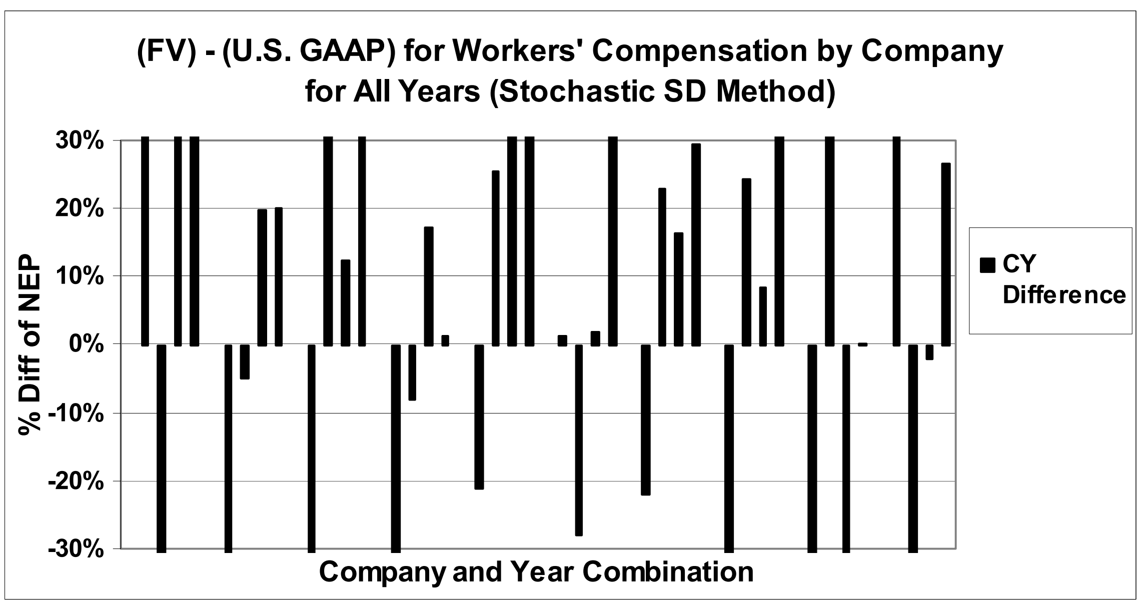


Chart 29: Workers' compensation. Difference in CYIL (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002). The Y-axis has been truncated at the shown values.

Current Accident Year

As shown in Chart 30, we generally observed that current accident year incurred losses on a fair value basis were greater than on a U.S. GAAP basis. In a few cases, the fair value basis current accident year losses were less than the U.S. GAAP basis amounts, as the discount amount more than offset the MVM amount.

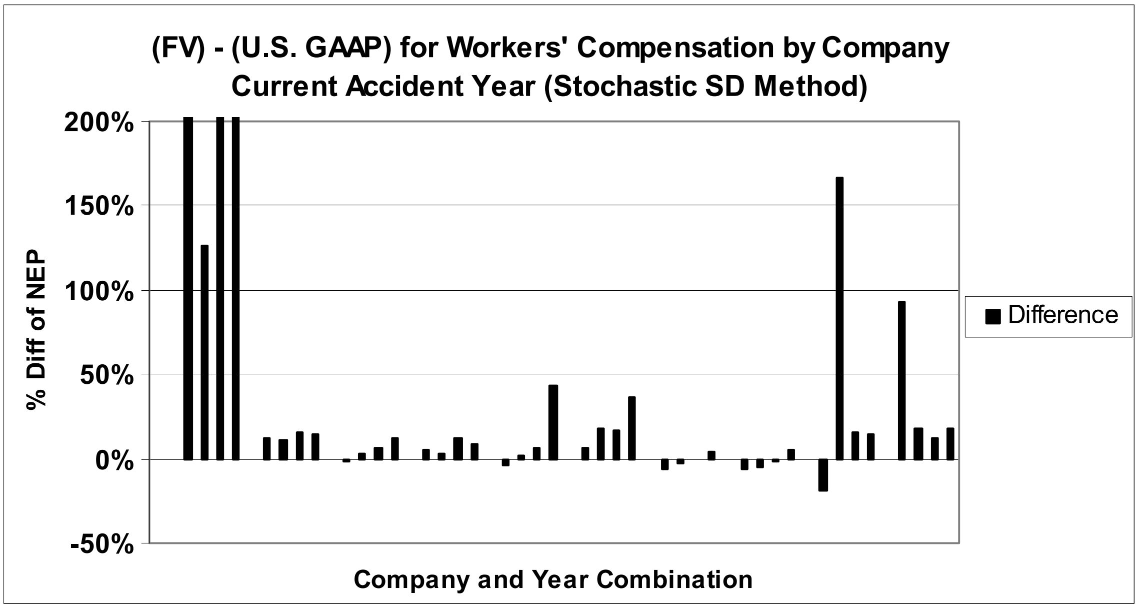


Chart 30: Workers' compensation. Difference in current accident year incurred losses (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002).

One-Year Development of Prior Accident Years

As shown in Chart 31, and numerically summarized in Table 6, we generally observed that the fair value prior accident year incurred losses were greater than the U.S. GAAP prior accident year losses, in contrast with the findings for personal auto liability.

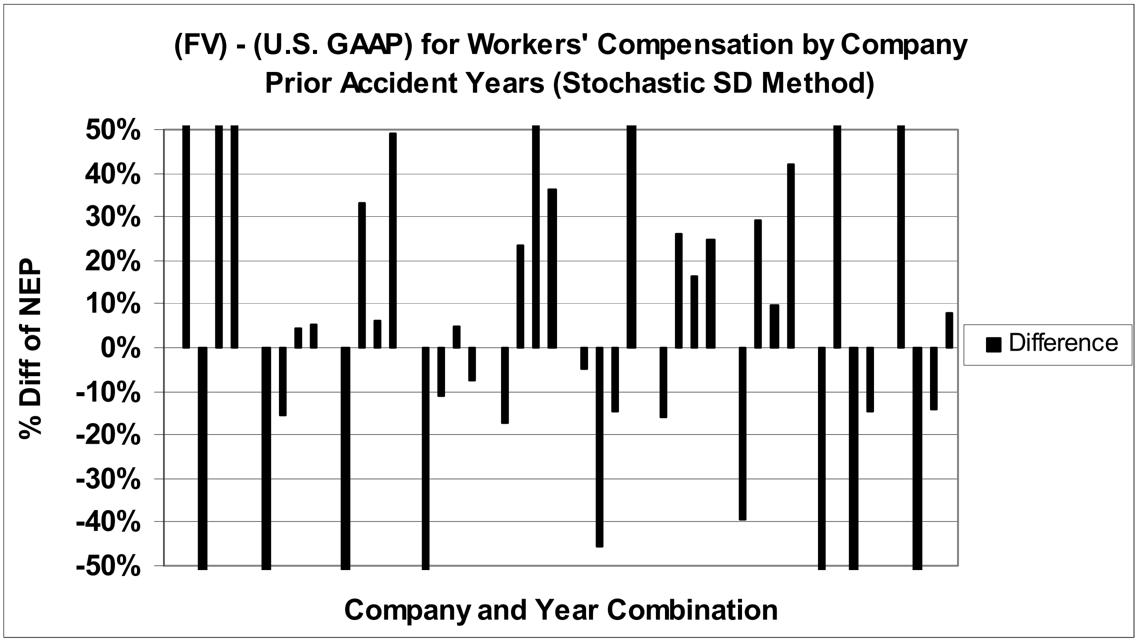


Chart 31: Workers' compensation. Impact of one-year development of prior accident years (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002). The Y-axis has been truncated at the shown values.

The average results for the companies in our sample are summarized by year in Table 6 below.

Basis	1999	2000	2001	2002	4-Year Average
U.S. GAAP	6%	-3%	7%	23%	9%
Fair Value	-23%	11%	16%	60%	17%

Table 6: Workers' compensation. Comparison of one-year development expressed in terms of percentages to net earned premiums. Please note that table excludes results from one company due to extraordinary results.

Over the four year period studied, the estimated one-year development on a fair value basis represented an average adverse development of 17%, or 8 points greater than on a U.S. GAAP basis. We observed that the relationships between the figures on the two bases of accounting during the 4-year period were affected by movements in interest rates during the period. Interest rates increased from year-end 1998 to year-end 1999, increasing the amount of discount and thereby reducing the level of reserves at year-end 1999 on a fair value basis. From year-end 1999 through year-end 2002, interest rates generally decreased, so that fair value reserves contained increasingly smaller amounts of discount, which emerged as one-year development of prior year losses on the income statement.

Medical Malpractice (Claims-Made)

The testing results on data for medical malpractice, in general, were less satisfactory and less stable than for the other two lines. Some development triangles were not complete (that is, less than 10 years of experience), and with our approach to adhere as closely as possible to the data-generated results, the results contained a higher degree of volatility than for the other lines. Insufficient data was available to calculate a standard deviation for one of the companies in the Medical Malpractice sample, creating the gap in some of the following charts where the results for that company would have appeared. We present the results without much comment.

1. *MVM by company at year-end 2002*

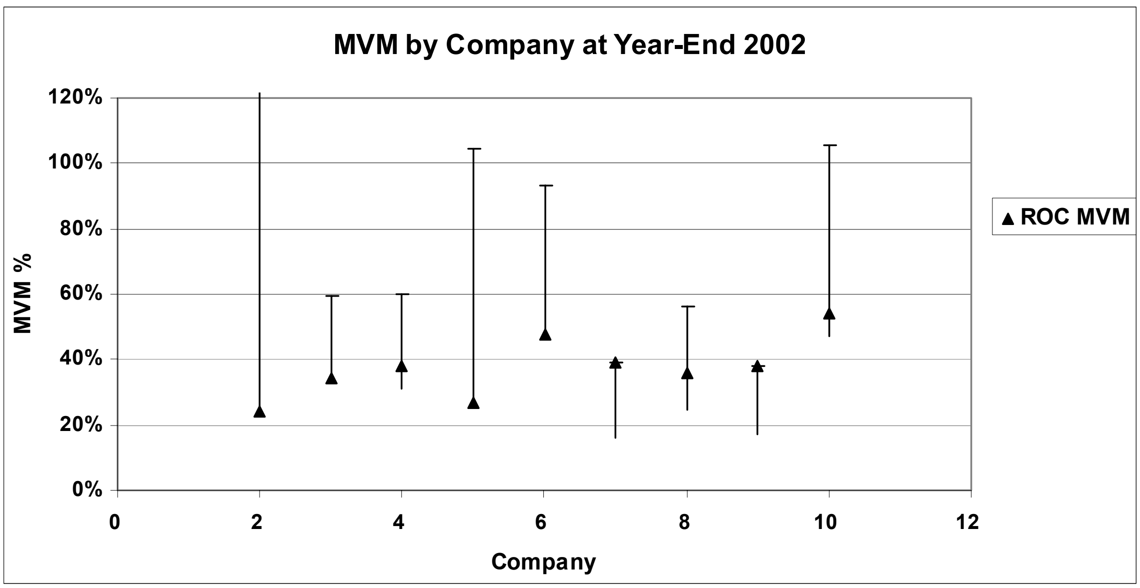


Chart 32: Medical malpractice. Range of indicated MVM percentages for the four models, by company, at year-end 2002. The companies are ordered from left to right by increasing size of company.

2. *MVM by company*

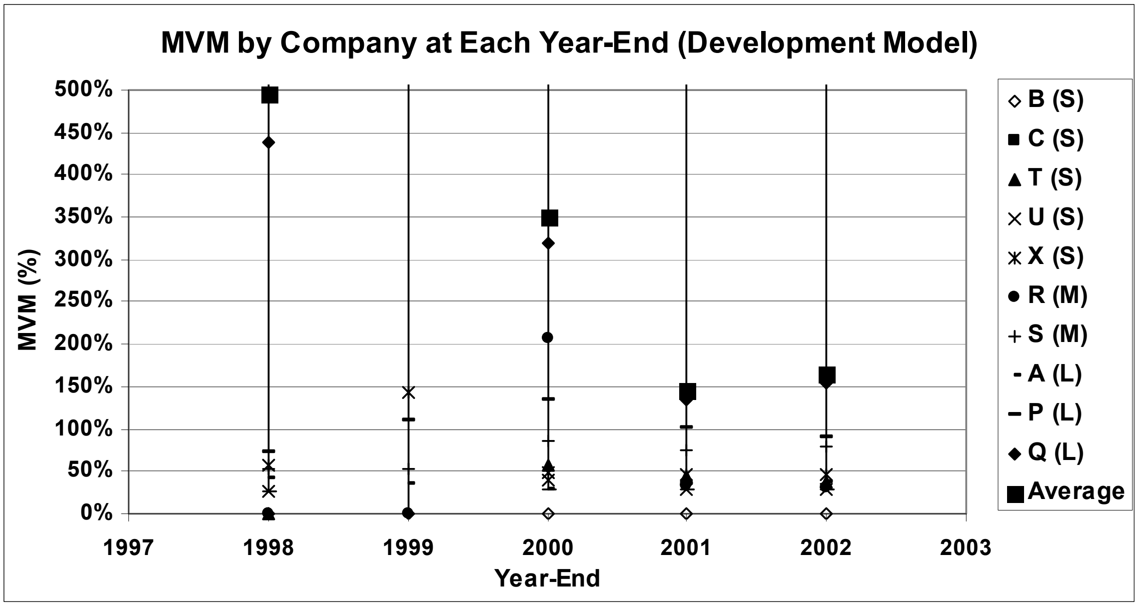


Chart 33: Medical malpractice. Range of indicated MVM percentages by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

3. *MVM by model*

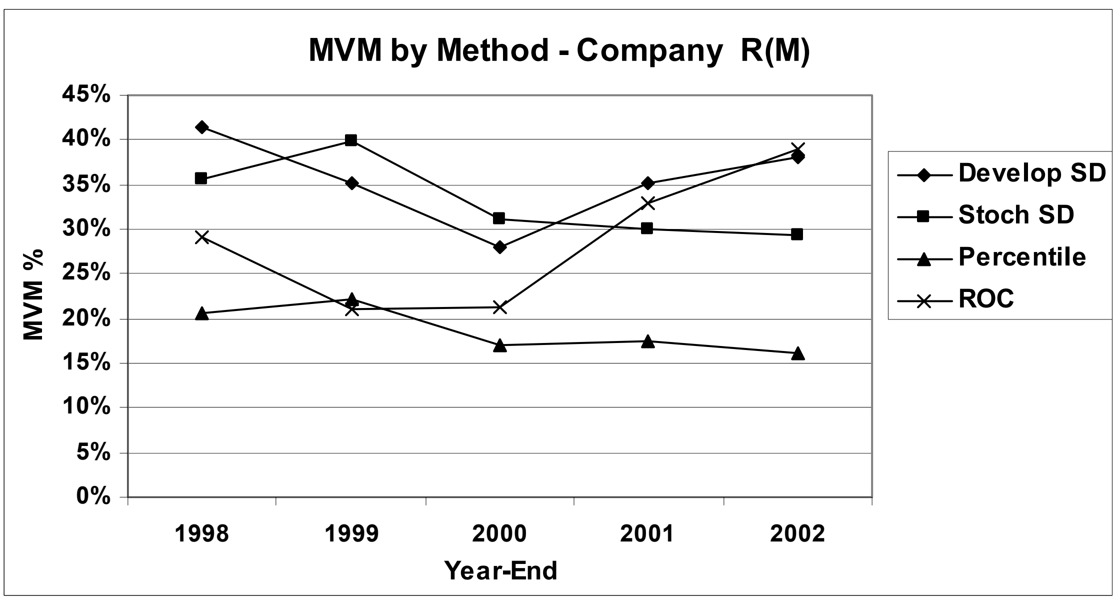


Chart 34: Medical malpractice. Indicated MVM percentages by model for a selected company by time period.

4. *MVM by company size*

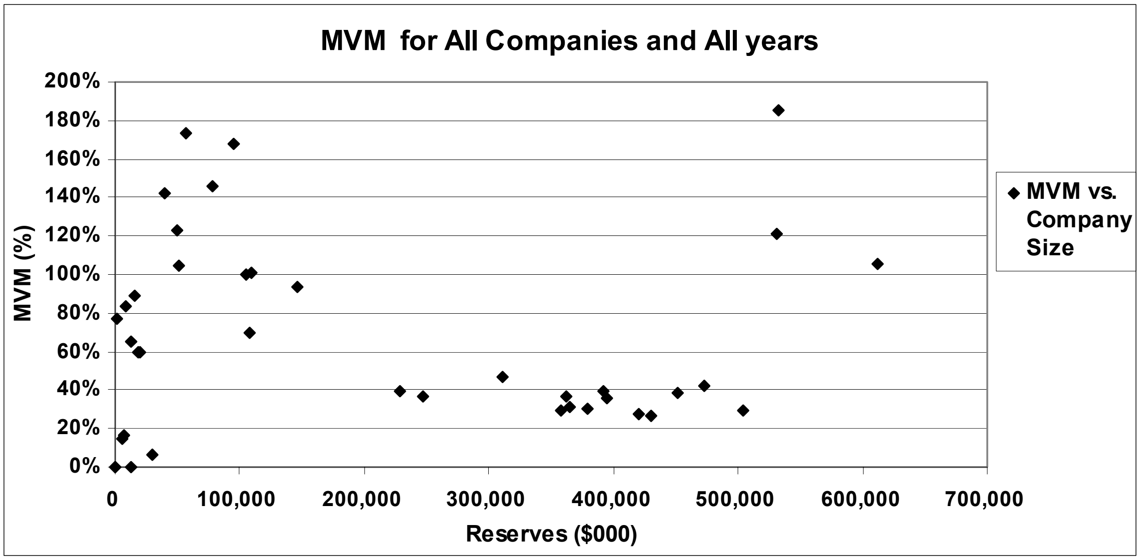


Chart 35: Medical malpractice. Indicated MVM percentages for all four models and all time periods plotted against company size.

Fair Value Factors

For Medical Malpractice, the discount element was significant, so many of the analyses showed the MVM being offset by the discount factor. Volatility of results across companies was much greater for this class of business, driven by a number of factors, including our prescriptive approach to the calculations across all companies in the sample. This is shown in the following charts.

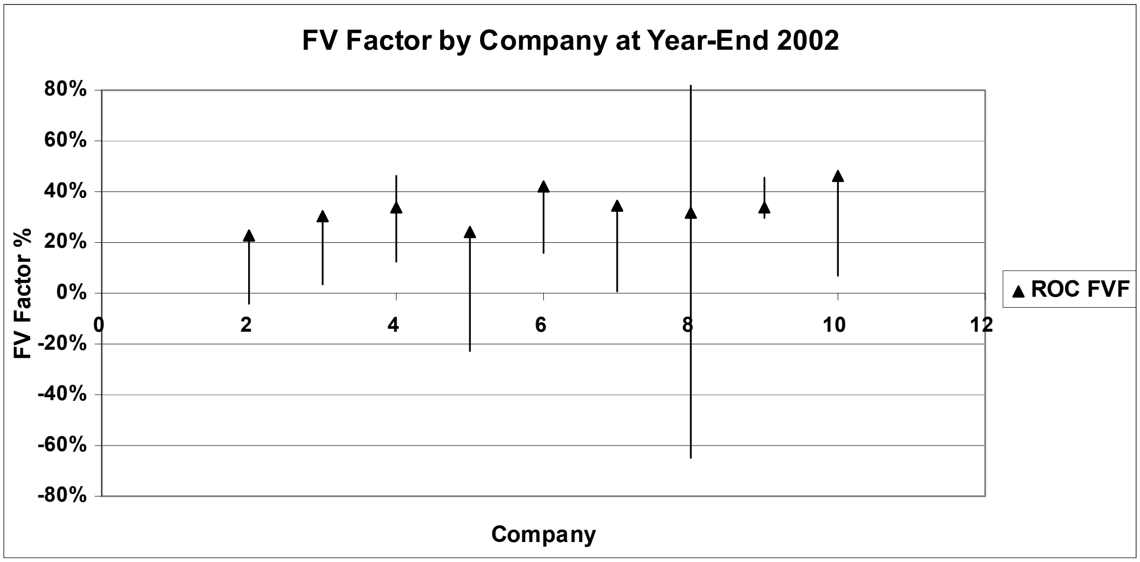


Chart 36: Medical malpractice. Range of indicated FVF percentages for each of the four models, by company, at year-end 2002. The companies are ordered from left to right by increasing size of company.

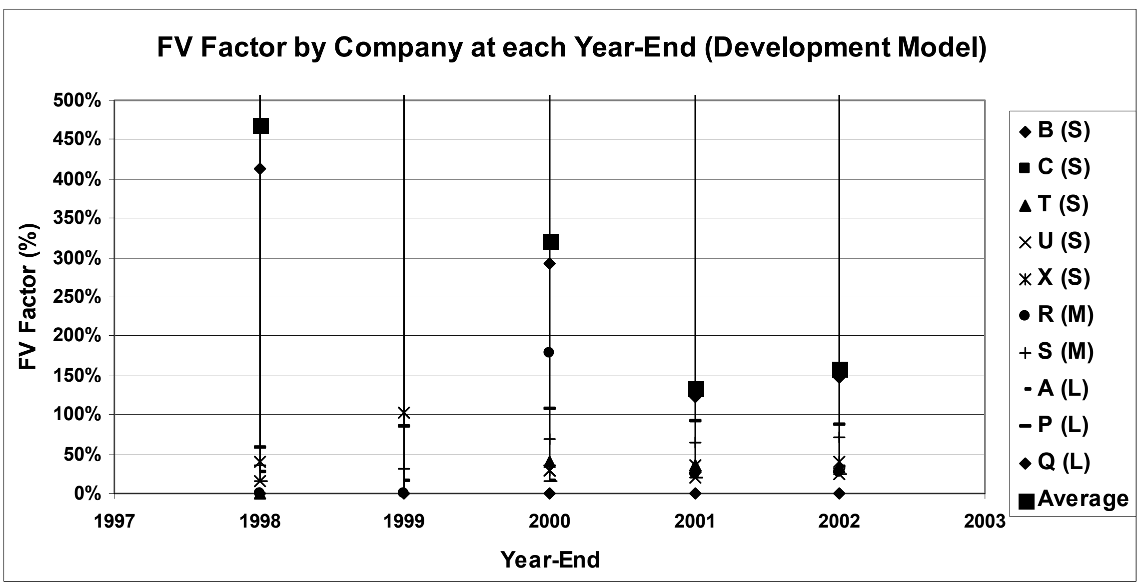


Chart 37: Medical malpractice. Range of indicated FVF percentages by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

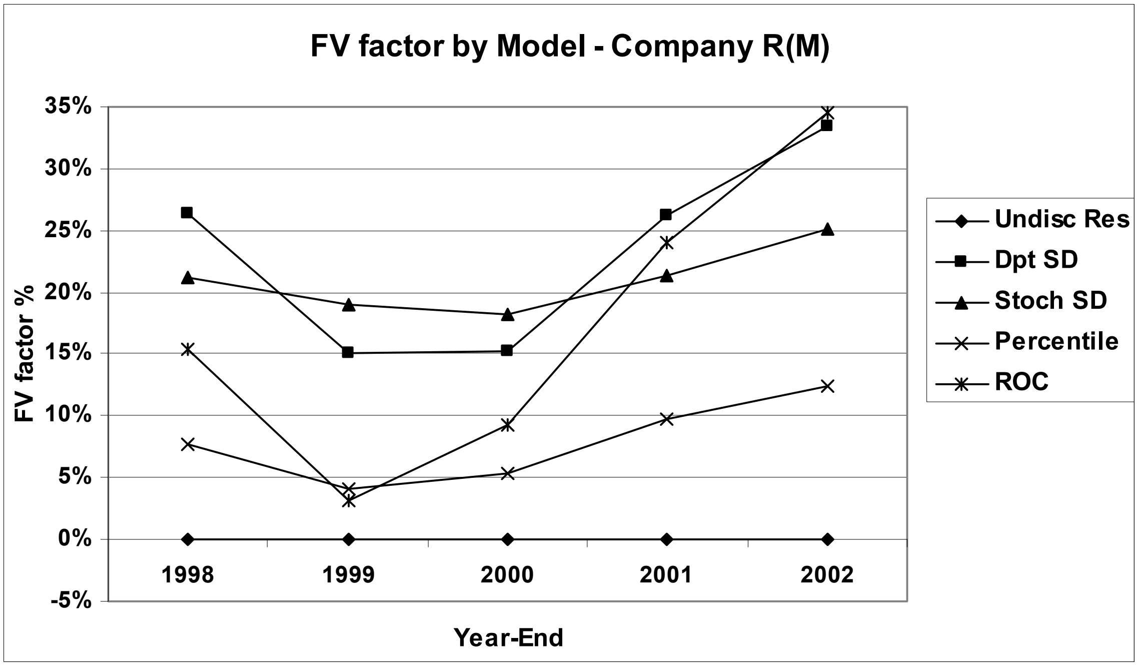


Chart 38: Medical malpractice. Indicated FVF percentages by model for a selected company by time period.

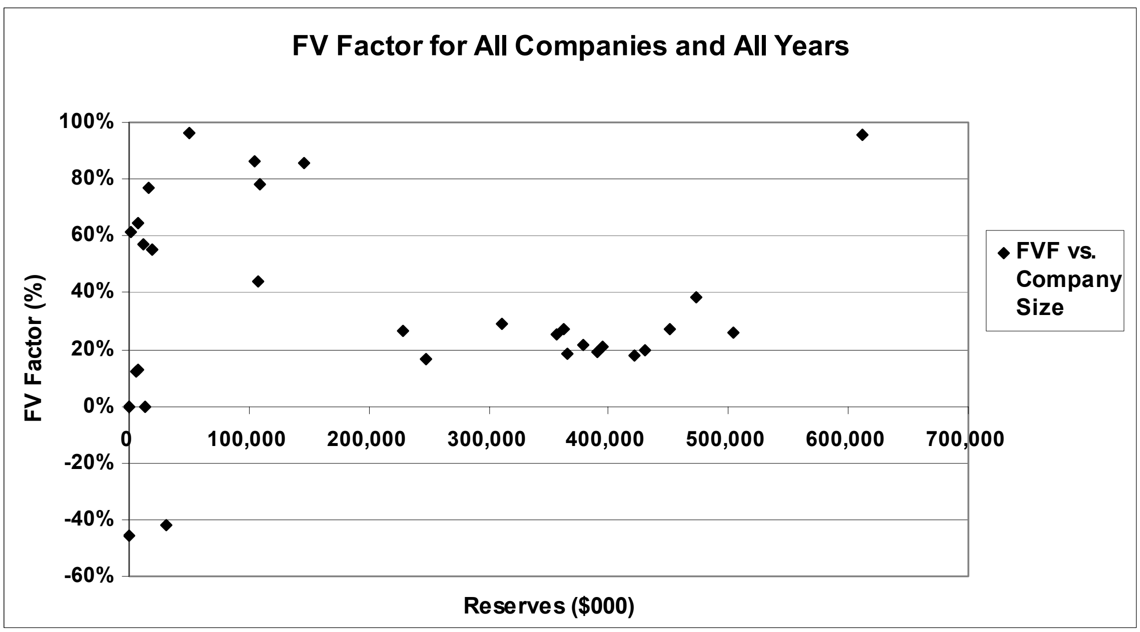


Chart 39: Medical malpractice. Indicated FVF percentages for all four models and all time periods plotted against company size.

Calendar Year Incurred Loss (CYIL) Impacts

1. *CYIL difference by company for calendar year 2002*

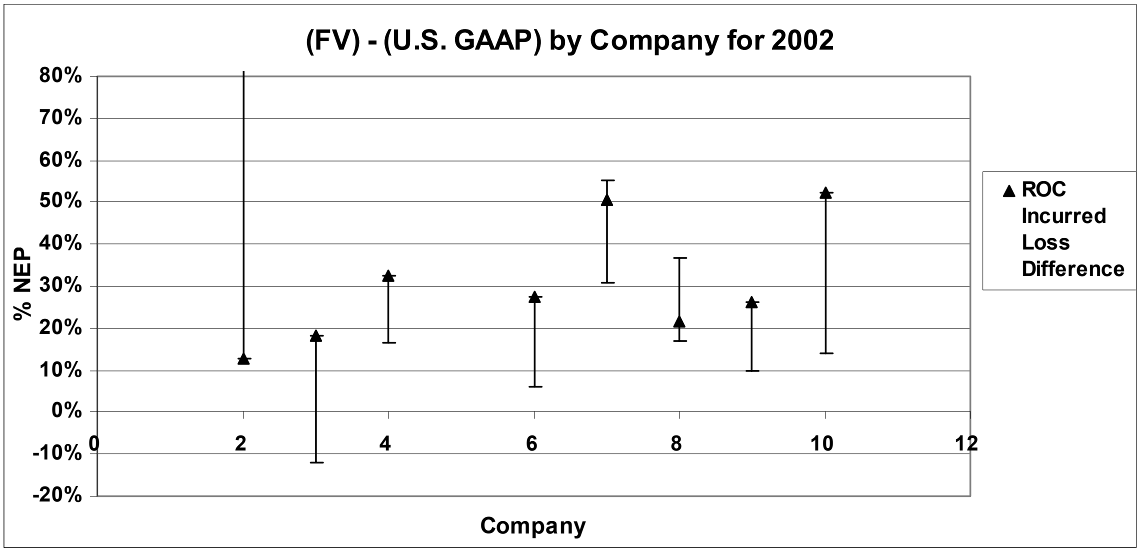


Chart 40: Medical malpractice. Range of the difference in CYIL (fair value basis less U.S. GAAP basis) for the four models, by company, for calendar year 2002. The companies are ordered from left to right by increasing size of the company.

2. *CYIL difference by company*

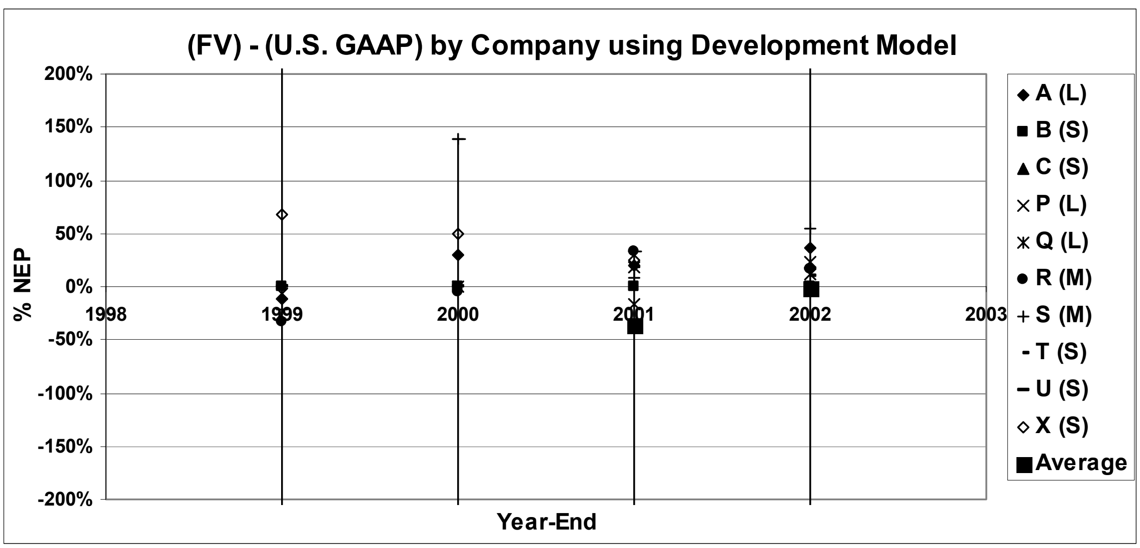


Chart 41: Medical malpractice. Range of the difference in CYIL (fair value basis less U.S. GAAP basis) by company and by time period, shown for the DM model. The straight average percentage is identified by the large square tick-mark. The letters S/M/L in parenthesis in the key indicate whether the company is 'small', 'medium' or 'large' (see Appendix for company size criteria).

3. *CYIL impact by model*

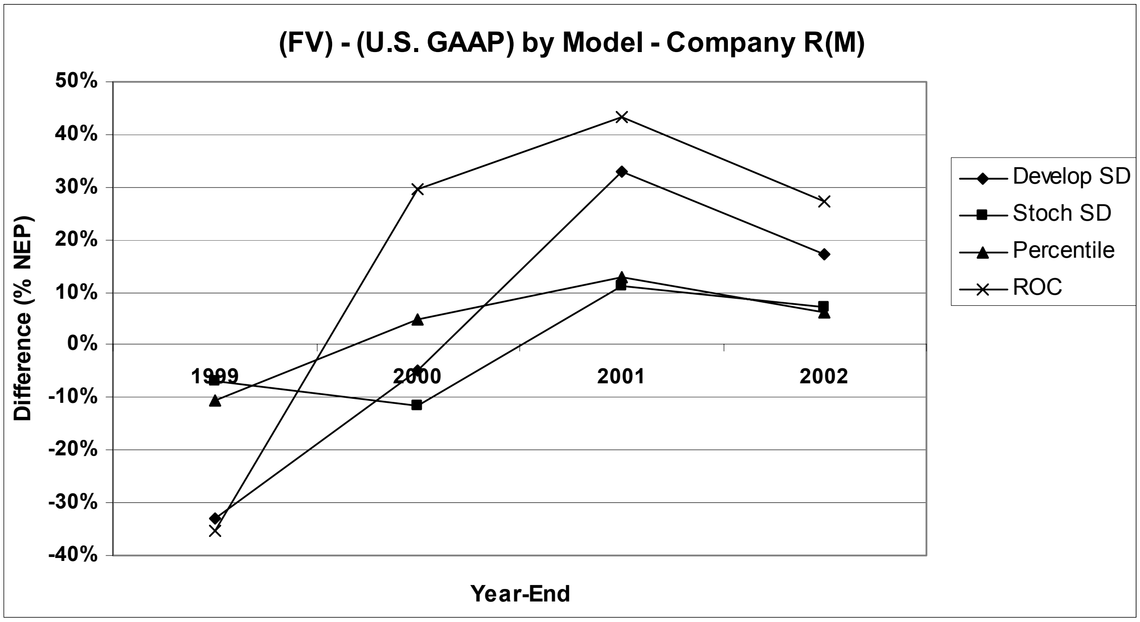


Chart 42: Medical malpractice. Difference in CYIL (fair value basis less U.S. GAAP basis) for a selected company by time period.

4. *CYIL impact by company size*

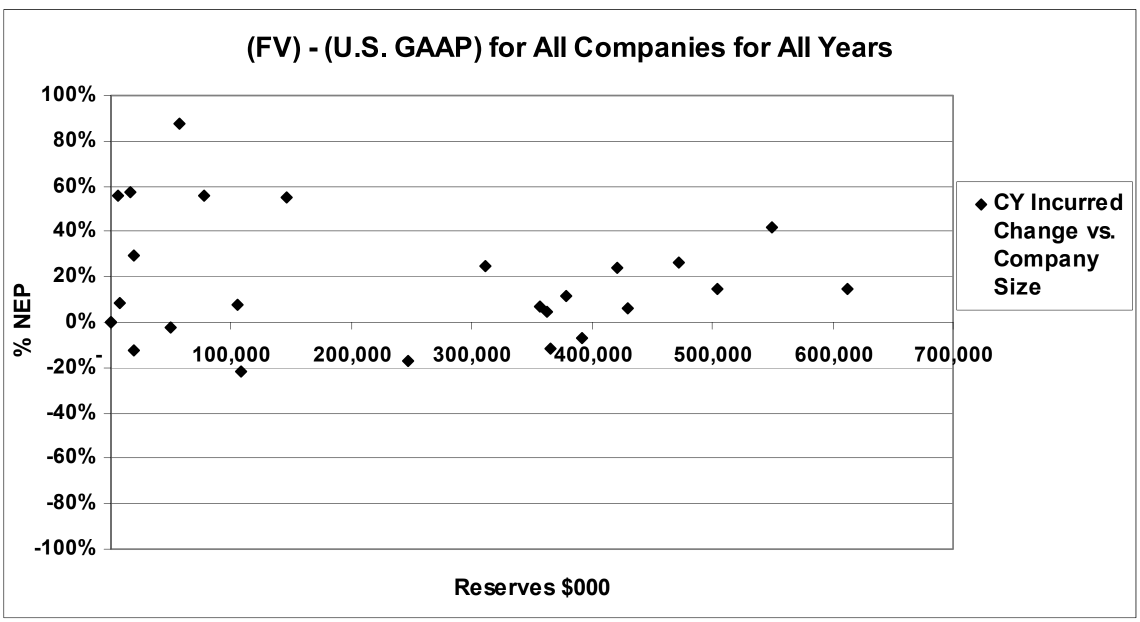


Chart 43: Medical malpractice. Difference in CYIL (fair value basis less U.S. GAAP basis) for all four models and all time periods plotted against company size). The Y-axis has been truncated at the shown values.

Impact by Accident Year

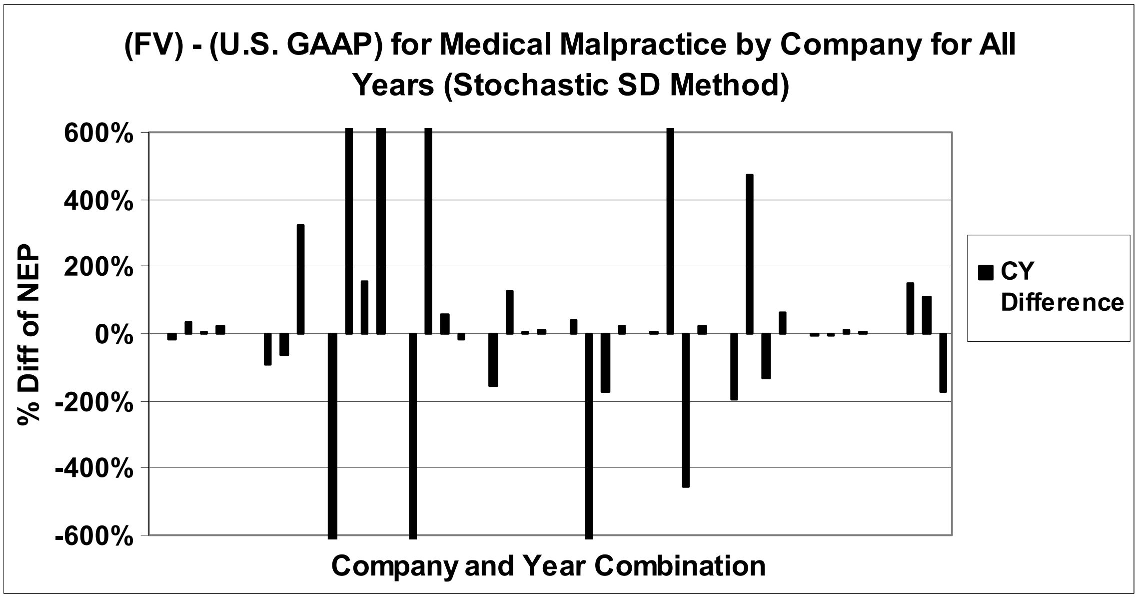


Chart 44: Medical malpractice. Difference in CYIL (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002). The Y-axis has been truncated at the shown values.

Current Accident Year

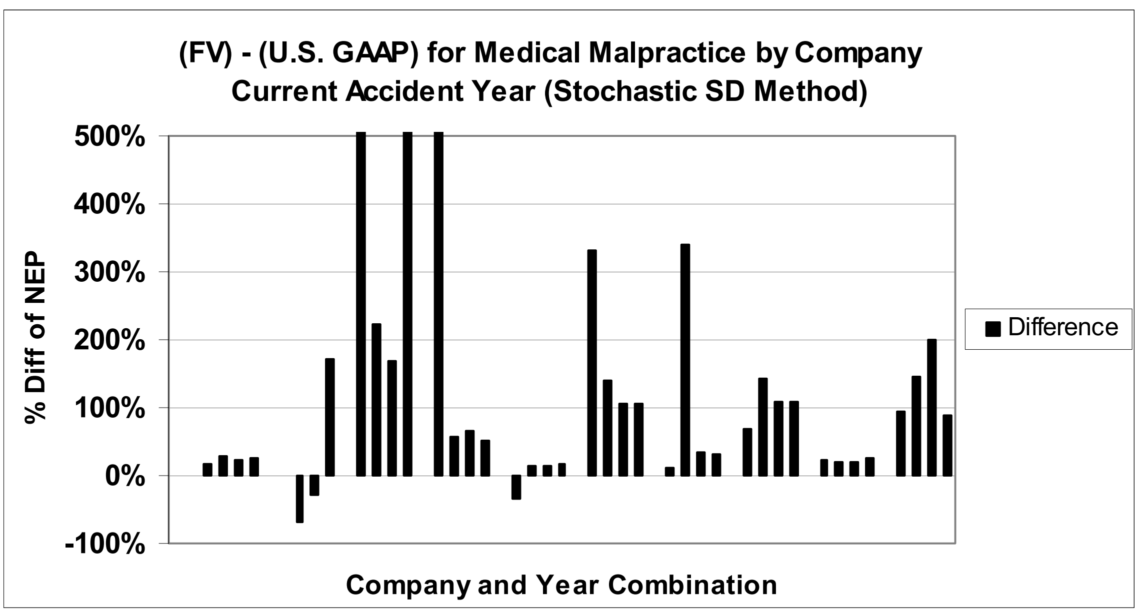


Chart 45: Medical malpractice. Difference in current accident year incurred losses (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002). The Y-axis has been truncated at the shown values.

One-Year Development of Prior Accident Years

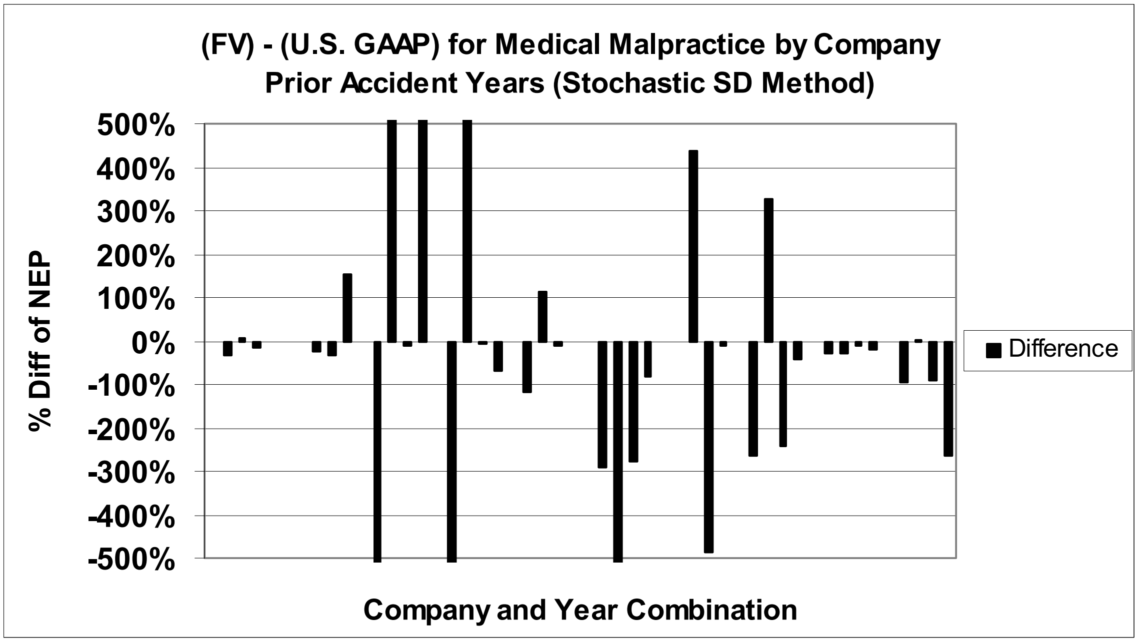


Chart 46: Medical malpractice. Impact of one year development of prior accident years (fair value basis less U.S. GAAP basis) by company and by time period, using the SS standard deviation model. Each series of four bars represents one company over the four calendar years studied (1999-2002). The Y-axis has been truncated at the shown values.

References

1. Mack, Thomas, "Distribution Free calculation of the Standard Error of Chain Ladder Reserve Estimates," *ASTIN Bulletin* 23, 2, 1993, pp. 213-225.
2. Casualty Actuarial Task Force on Fair Value Liabilities, December 1999-August 2000, "CAS Task Force on Fair Value Liabilities White Paper on Fair Valuing Property/Casualty Insurance Liabilities".
3. International Accounting Standards Board, Draft Statement of Principles, www.iasc.org.uk

Appendix

Company Size Criteria

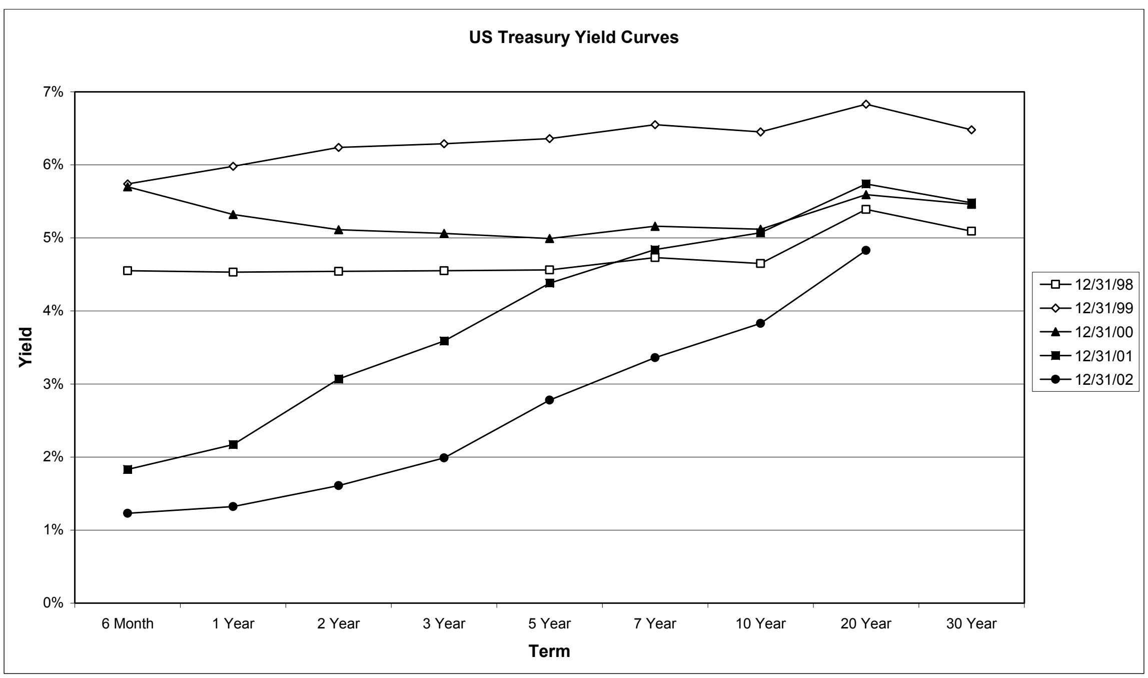
For each of the three lines of business, we applied the criteria shown in **Table A1** in selecting our sample companies, based on 2002 net written premium:

Line of Business	Large	Medium	Small
Personal Auto Liability	>$1bn	$200m to $1bn	<$200m
Workers' Compensation	>$500m	$200m to $500m	<$200m
Medical Malpractice	>$150m	$50m to $150m	<$50m

Table A1: Size criteria applied in selecting sample companies to analyze.

Interest Rates

The interest rate yield-curves used in our testing are shown in the following chart:



Return on Capital Model

This approach models the fair exchange between a willing buyer and willing seller in an arms-length commercial transaction.

Inputs

A number of inputs are required to run this model as shown in Exhibit A1.

Year-End	2002								
Class	Duration (Years)	Interest Duration	Interest Matched	RoC Required	Tax Rate	RBC Factor	RBC Inv Adj	RBC Multiple	Solvency Required
Auto	1.76	1.54%	2.14%	10.0%	30%	25.4%	92.1%	2.0	47%
W/C	4.62	2.63%	3.63%	10.0%	30%	27.3%	87.2%	2.0	48%
Med Mal	5.93	3.05%	4.22%	10.0%	30%	56.5%	80.8%	2.0	91%

Payment Patterns									
Class	1	2	3	4	5	6	7	8	9
Auto	38.9%	24.2%	17.5%	10.4%	6.1%	1.8%	0.3%	0.3%	0.2%
W/C	22.0%	15.8%	10.7%	7.0%	3.8%	3.5%	3.5%	3.6%	3.1%
Med Mal	29.2%	20.9%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Exhibit A1: Example extract from inputs to the Return on Capital Model.

The assumptions required for this model, many of which are shown in Exhibit A1, are:

- *Loss payment patterns* – Company specific patterns implied by the ratio of current payments to booked ultimate losses are used, adapted where necessary to deal with unusual data points and outliers.
- *Interest rates* – Treasury yields are used as described in the main body of this paper.
- *Reserves to surplus ratio (solvency requirement)* – This was calculated as twice the amount produced by the RBC factors.
- *Target return on capital* – A return of 10% per annum is assumed across all lines of business at each year-end considered in our analysis.
- *Tax rate* – An effective rate of 30% is assumed.

Calculations

The assumptions above are used in a cash flow model that consists of the following elements:

- Undiscounted/discounted loss payments
- Interest earned on loss reserves
- MVM at the start and end of each year
- Interest earned on MVM
- Solvency Margin (e.g., capital) at start and end of year

- Interest earned on Solvency Margin
- Revenue Profit before and after tax
- Cash flow before and after tax

Output

The additional "premium" (aka, Market Value Margin) is the value we then solve for, such that buyer achieves the target return on capital.

Note that the reserves to surplus ratio operates in a manner by which the MVM is part of the claims reserves; that is, the solvency margin is held on the best estimate discounted reserves plus the MVM.

Development Model

Under this approach the variation in historical loss development drives an estimate of the standard deviation of the reserve distribution. The algorithm described by Thomas Mack (Mack, 1993 (1)) is used to quantify the variation.

Inputs

The inputs required for this model are:

- *Paid and reported loss development triangles* – These were from Schedule P.
- *Recorded unpaid losses* – These were obtained from Schedule P
- *Loss payment patterns* – Company specific patterns implied by the ratio of current payments to booked ultimate losses are used, adapted where necessary to deal with unusual data points and outliers.
- *Loss reporting patterns* – These are needed in the evaluation of variation of historical reported loss development experience in relation to expected experience. The patterns were derived from company specific experience, using the level of booked ultimate losses by accident year.
- *Interest rates* – Treasury yields are used as described in the main body of the paper.

Calculations

The Mack method of assessing variability is applied to both paid and reported loss data, giving two indications of variation. Illustrative calculations are shown in **Exhibit A2.**

	Estimated Standard Deviations					
		(1)	**(2)**	**(3)**	**(4)**	**(5)**
	AY	Paid ESE	Rptd ESE	Select	% Bk R	Bk Res
A	Prior			1,211	**80%**	1,511
B	1993			42	**80%**	53
C	1994	542	369	456	92%	496
D	1995	1,217	664	940	68%	1,375
E	1996	2,693	1,121	1,907	42%	4,493
F	1997	3,472	2,671	3,071	34%	8,914
G	1998	8,909	8,580	8,744	41%	21,159
H	1999	10,288	10,812	10,550	31%	33,553
I	2000	19,748	20,225	19,986	26%	78,204
J	2001	23,923	30,586	27,254	19%	140,943
K	2002	34,820	35,125	34,973	13%	260,022
L	Last 9	56,682	60,398	58,540	11%	549,159
M	Total	Adj to incl Prior to 9		58,552		550,723
			Sums	Alloc	ESD %	Bk Res
N	Current		34,973	18,763	7.2%	260,022
O	All Prior		74,162	39,789	13.7%	290,701
P	Total		109,134	58,552	10.6%	550,723

Exhibit A2: Example output from the Development Model.

- We applied the Mack algorithm to the paid and reported loss development data to generate two sets of indications for the estimated standard errors of the reserve distribution for each accident year and all (in this case, latest 9) years combined. (Rows C-K & L, Columns 1 & 2).
- For the purpose of this study, we utilized the average indication of variability from the two sets of data for each of the latest 9 accident years and the latest 9 years combined. (Rows C-K & L, Column 3)
- We utilized the average variation (as a percentage of the booked reserves) from the accident years at the 8th and 9th development ages as a basis to assign a variation to the oldest (10th) accident period as well as the tail period.
(Rows A-D, Column 4).
- The booked reserves are shown in Column 5.
- We derived the standard deviation for all years combined based on an assumption of independence among the tail period, the 10th oldest year, and the latest 9 years combined. (Row M, Column 3)

➢ For our analysis of results for current accident year and all-prior accident years, we allocated the overall measure of variation to these two sub-periods based on their relative individual variation measures. (Rows N-P, Columns 2 & 3).

We also evaluated a measure of payment-timing variation based on the variation in the historical ratios of payments (at each development age) to ultimate losses (as booked at the time). We evaluated the standard deviation of the cumulative payment pattern at each development age. For deriving an estimated MVM, we accelerated the cumulative payment pattern by "x" standard deviations to model the payment uncertainty aspect of the variation.

Output

The output from the Development Model consisted of the MVM's for all accident years, the current accident year, and all prior accident years, as well as the discount factors reflecting the two approaches taken.

The calibration process described in the main body of this paper was used to determine the multiple of the standard deviation to be applied in calculating the MVM.

Stochastic Simulation Method

Inputs

The inputs for this model are the same as those for the Development Model (excluding the loss reporting pattern).

Calculations

The approach here is to establish a set of "perfect" development data, based on an expected payment pattern and the booked ultimate losses. Then we established a population of actual-to-expected ratios of claim payments, and the expected future payout of the booked loss reserves using the expected payment pattern. We then simulated numerous times from the distribution of potential future payouts, using the population of actual-to-expected ratios as the measure of payout variation. This approach reflected variation in both ultimate payout amount and timing.

Output

Example model output is shown in **Exhibit A3.**

4.54%	Interest Rate	Sigma	Calc	Average	SD	50.0%	55.0%	60.0%
PPAL/Medical - DBI	4.54%	4.9%	91.83	91.63	5.52	91.36	92.05	92.79
PPAL/Medical - MI	4.54%	4.9%	91.82	91.77	5.62	91.53	92.36	93.05
W/C - DBI	4.68%	13.7%	70.91	70.90	19.47	67.61	69.78	72.59
W/C - MI	4.90%	13.7%	69.93	69.91	19.03	66.93	68.91	71.05
Med Mal - DBI	4.53%	245.0%	102.85	106.66	591.55	41.35	51.29	63.95
Med Mal - MI	4.56%	245.0%	102.87	97.19	917.32	47.43	57.88	70.23

Exhibit A3: Example output from the Stochastic/Simulation Model.

The calibration process described in the main body of this paper is used to select the multiple of the standard deviation to be applied in calculating the MVM.

Model Calibration

To provide additional detail regarding the calibration of the models, the following excerpt is presented for the Personal Auto Liability line.

A complete set of assumptions was used in the ROC model to generate an MVM for each of the three companies chosen for the calibration phase of our study. We then applied the Stochastic Simulation method and the Development method to the data to derive estimates for the standard deviations and distributions of the reserves. We calculated the SD Multiple as the estimated MVM from the ROC model divided by the standard deviation from each of the stochastic and development methods. We also identified the percentile of the reserves distribution from the Stochastic Simulation method that matched the MVM from the ROC model. Selected figures from the calibration are shown in Exhibit A4:

2002
PPAL/Medical

Stochastic Model

SD Multiple:	**2.0**	
Percentile:	**90%**	
Size	**SD Multiple**	**Percentile**
Large	3.23	99%
Medium	2.08	96%
Small	0.63	77%

Development Model

SD Multiple:	**1.2**
Size	**SD Multiple**
Large	1.89
Medium	1.26
Small	0.48

Exhibit A4: Calibration of DM and SS models for Personal Auto Liability.

Within this small portion of our overall analysis, the reader can observe the variation in the indicated multipliers and percentiles and their apparent relationship with the size of the company.

In recognition of the calibration sensitivity to the assumptions made, we performed some further investigation, in particular examining the sensitivity of the calibration to the level of solvency capital required for the Personal Auto Liability line of business. This analysis was performed using the medium sized company from the initial calibration, and was chosen as the calibration for this company was similar to the average values selected to apply to all companies for this line of business. Table A2 highlights the sensitivities present; we included the original calibration (using 2.0 times the RBC requirement) and highlighted this row in italics:

Risk-Based Capital Multiple	Development Method SD Multiple	Stochastic Simulation Method SD Multiple	Stochastic Simulation Method Percentile
0.5	0.3	0.5	69%
1.0	0.6	1.0	84%
1.5	0.9	1.5	93%
2.0	***1.3***	***2.1***	***96%***
2.5	1.6	2.7	97%
3.0	2.0	3.3	98%
3.5	2.5	4.1	100%
4.0	3.0	4.8	100%

Table A2: Sensitivity of Personal Auto Liability calibration results to alternate levels of required solvency capital is illustrated in this table.

Definitions/Abbreviations

CAS – Casualty Actuarial Society

Development Model (DM) – method of assessing the Market Value Margin using the Thomas Mack algorithm.

FASB – Financial Accounting Standards Board

Fair Value – The amount for which an asset could be exchanged or a liability settled, between knowledgeable, willing parties in an arm's length transaction

FVF – Fair Value Factor, denoting the combined effect of the Market Value Margin and discount factor

IASB – International Accounting Standards Board, the successor to the International Accounting Standards Committee, IASC

IFRS – International Financial Reporting Standard

MVM – Market Value Margin

ROC – Return on Capital

RBC – Risk Based Capital, a regulatory framework by which property/casualty insurers determine their required level of solvency capital

SS – Stochastic/Simulation method of assessing the Market Value Margin