2011 Research – Short-Term Project Report

A Report of the CAS Underwriting Risk Working Party

Abstract: At the request of the American Academy of Actuaries, the CAS formed the Risk-Based Capital (RBC) Underwriting Risk Working Party (URWP) to research the current RBC formula for measuring underwriting risk and the procedures for calibrating the formula's parameters (the Current Calibration Method). The research unveiled various accuracy and consistency issues with the Current Calibration Method. Some alternatives are investigated and areas of further research are suggested, including volume of data, data filtering, curve fitting, the investment income offsets (IIO) discount rate, time horizon, and the relative impact of premium and reserve charges by line. This paper presents results of the URWP's short-term charge.

Keywords. risk-based capital; RBC; underwriting risk, reserve risk; premium risk; risk horizon

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EXECUTIVE SUMMARY

In 2011 the Underwriting Risk Working Party (URWP) of the Casualty Actuarial Society (CAS) researched the potential for improvements to the calculation of underwriting risk (reserve and premium) charges within the constraints of the current NAIC RBC formula and its current parameter calibration procedures. This report summarizes the results of our short-term charge.

- The current data sources—confidential company RBC filings and the most recently available Schedule P—yield too few observations for stable estimates of RBC factors from one calibration cycle to the next. Additional data sources should be investigated.
- Filtering eliminates a significant amount of company experience from the current calibration method. For many lines of business the majority of the companies in the industry are eliminated; for two lines, all companies are eliminated. New ways to filter out questionable data should be investigated. Possible alternatives are discussed in the report.
- The method of basing the RBC reserve risk factor on empirical reserve run-off ratios is subject to high volatility due to the limited data available and to the natural behavior of mathematical ratios. We are quite confident that it is inevitable that from one calibration cycle to the next RBC factors will change to an unsatisfactorily significant degree. This volatility may be mitigated by additional data, alternative filtering procedures, basing charges on statistics from fitted curves rather than from the empirical data alone, or designing

structural changes to RBC's reserve risk calculation.

- There is evidence that the current calibration method understates the indicated reserve risk charge for companies with smaller booked reserves and overstates the charge for companies with larger booked reserves. Some method of varying the factor by size of booked reserve could be investigated.
- The Investment Income Offset (IIO) discount factor of 5% that has always been in place is inconsistent with the current environment. Although selecting the most appropriate discount rate and allowing it to float with the market is not without controversy, research is warranted to improve the implied safety margin of the RBC's underwriting risk. This research should be coordinated with other RBC risk areas.
- There are many differences between the NAIC RBC and the Solvency II approach to risk-based capital. One difference is the time horizon for measuring reserve risk. The Solvency II Standard Formula measures reserve risk over a one-year time horizon while RBC measures reserve risk over the claim run-off period. We illustrate RBC reserve risk factors on the basis of a one-year risk horizon from the RBC data currently available. An analysis of the relative strengths and weaknesses of the current run-off horizon versus a one-year horizon is beyond the scope of the URWP's short-term charge.
- Procedures for comparing the performance of alternative RBC formulas and calibration methods should be investigated. One useful approach investigated in the report is based on pro forma premium to Company Action Level RBC underwriting risk ratios.
- A comparison of RBC premium and reserve risk factors suggests that companies entering a line of business may have a lower RBC charge per dollar of premium than established companies.

1. INTRODUCTION

We present a summary of the research as of mid-2011 conducted by the Underwriting Risk Working Party (URWP) of the Casualty Actuarial Society (CAS).

1.1 Research Context

At the request of the American Academy of Actuaries the CAS formed the Underwriting Risk Working Party (URWP) to conduct research regarding the Underwriting Risk (Premium and Reserves) components of the NAIC's Risk-Based Capital (RBC) formula. The Academy requested the research to take place in two stages, through a long-term and a short-term charge.

1.1.1 Long-Term Charge

> *Provide general research that identifies better ways to quantify reserve and premium risks in solvency monitoring, and to determine capital charges to account for those risks.*

The measurement of underwriting risk would involve identification of an amount of capital for each company that specifically reflects the company's underwriting risk profile to the extent practical in an RBC context. To accurately reflect risk, detailed measurements might use techniques that differ from the current RBC formula, and development of such techniques is left as a long-term research subject.

1.1.2 Short-Term Charge

> *Research ways to improve the calculation of reserve and premium charges within the constraints of the current NAIC RBC formula and the current parameter calibration procedures.*

The URWP recognizes that accurate measurement of risk may require structural changes to the measurement formula. However, in the short term, we analyze some of the assumptions and implications in the current RBC formula and propose possible improvements within the existing framework.

1.2 Objective

We provide details on our investigation into the short-term charge and explain the long-term issues that we may address in future research.

1.3 Disclaimers

The analysis and opinions expressed in these pages are solely those of the Working Party members, and in particular are not those of the members' employers, the Casualty Actuarial Society, or the American Academy Actuaries.

Equivalent values in separate tables may differ due to rounding.

1.4 Outline

The remaining sections in this report are as follows:

Section 2: Background and Methods

Section 3: Results and Discussions (Short-Term Issues addressed in this report)

Section 3.1 Filtering

Section 3.2 Risk Charge Measurement

Section 3.3 Investment Income Offset (IIO)

Section 3.4 Observations Regarding Solvency II

Section 3.5 Pro Forma Premium to Company Action Level (CAL) RBC Underwriting Risk Ratios

Section 4: Conclusions and Areas of Further Research

Acknowledgements and Appendices

2. BACKGROUND AND METHODS

2.1 Introduction to the Current Calibration Method

When RBC was established in 1993, premium and reserve risk charges were based on analysis and judgment. The factors were updated in 2008, 2009, and 2010. The RBC factors are currently based on an approach we call the Current Calibration Method. The selected factors adopted for 2008, 2009 and 2010 were the factors indicated by the Current Calibration Method subjects to limitations ("caps") in movement of ±15% each year for 2008 and 2009. In 2010, the cap was ±5%.

The Current Calibration Method begins with 10x10 triangles (ten accident years by ages 1 through 10 years) for all lines of business for all companies. The source is Schedule P data for long-tailed lines and the RBC filing for short tail lines[1]. Data for certain companies is removed from this data set and extreme values for some data points are limited based on criteria which we discuss below. We refer to this data editing as "filtering." Filtering in the Current Calibration Method is described in section 3.1.

Reserve Risk

For calculation of the reserve charges, the Current Calibration Method uses nine data points for each selected company by RBC line of business. The first of these data points is the total reserve development on total reserves from the oldest evaluation date to the current statement date, representing nine years of development. The next data point is total reserve development from the second-oldest evaluation date to the current statement date, representing eight years of development. The subsequent points follow the same pattern.

The Current Calibration Method then calculates a statistic, currently the 87.5th percentile, from these data, which, after investment income offset, is considered the indicated 'INDUSTRY LOSS & EXPENSE RBC%" factor that would otherwise appear in Line 04 in report PR016 for the relevant line of business. This indicated factor is subject to the following limitations before becoming the final selected factor (or "RBC charge") for that line:

- The selected INDUSTRY LOSS & EXPENSE RBC% cannot be less than 5% (the "5% minimum charge").
- The change in the selected factor from year to year is "capped."
- Other potential NAIC overrides.

[1] It is not uncommon for companies to complete their RBC filings for short tail lines with only the most recent evaluation (i.e., the list diagonal of the accident year triangle). Since incomplete triangles flag companies to be eliminated in the filtering process (see Section 3.1), such "shortcut" company practices curtail the volume of data for short tail line RBC calibration.

Premium Risk

For calculation of the premium charges, the Current Calibration Method uses the ten accident year loss ratios evaluated at the current date by RBC line of business. The maturity of this loss ratio for the oldest accident year in Schedule P is ten years; for the second-oldest accident year, nine years; and so forth.

The Current Calibration Method then calculates a statistic, currently the 87.5th percentile, from these data, which, after investment income offset, is considered the indicated ‘INDUSTRY LOSS & EXPENSE RATIO” factor that would otherwise appear in Line 04 in report PR017 for the relevant line of business. This indicated factor is subject to the following limitations before becoming the final selected factor (or “RBC charge”) for that line:

- The selected INDUSTRY LOSS & EXPENSE RATIO plus the industry average company operating expense ratio (27.5% currently) less unity cannot be less than 5% (the “5% minimum charge”).
- The change in the selected factor from year to year is “capped.”
- Other potential NAIC over-rides.

3. RESULTS AND DISCUSSION

3.1 Filtering

Filtering in the Current Calibration Method is primarily accomplished by eliminating entire companies from the RBC database according to the following rules.

For reserve risk, a company is eliminated if it has:

- negative paid values in any AY as of any statement date.
- negative reserve values in any AY as of any statement date.
- negative incurred loss and DCC in any AY as of any statement date.
- fewer than ten accident years with non-zero loss data as of some evaluation date.

For premium risk, a company is eliminated if it has:

- average AY earned premium less than $500,000.
- any AY loss ratio <= 0%.
- less than eight AYs with net earned premium greater than 20% of its average earned premium for all AYs.
- fewer than ten years of earned premium.

For companies that remain, filtering takes the form of constraints on the observations that appear in the RBC database:

- For the calculation of premium risk, loss ratios are capped at 300%.
- For reserve risk, reserve run-off ratios, expressed as the ratio of reserve development to booked reserves, are constrained to lie between -100% and 400%.

Filtering in the Current Calibration Method eliminates a large portion of industry data for all lines of business. In most lines, less than 50% of available industry observations are used in developing reserve and premium charges, as shown in Exhibit 1 below.[2]

[2] Unless otherwise noted the RBC data used in this report is as of 12/31/2008.

Exhibit 1: Current Company Filtering

Percentage of Industry Data Utilized						
Line	Line Letter	Reserve Dollars	Reserve Companies	Premium Dollars	Premium Companies
(1) H/F	A	81.7%	39.0%	95.7%	57.0%
(2) PPA	B	85.1%	42.5%	95.6%	57.0%
(3) CA	C	80.6%	40.2%	90.5%	53.7%
(4) WC	D	82.5%	41.4%	91.1%	54.9%
(5) CMP	E	71.0%	40.3%	93.0%	56.7%
(6) MM Occurrence	F1	43.0%	10.7%	74.0%	20.3%
(7) MM CM	F2	59.2%	14.2%	71.9%	21.3%
(8) SL	G	64.5%	18.7%	83.3%	31.2%
(9) OL	H	64.4%	27.7%	89.8%	43.5%
(11) Spec Prop	I	29.9%	26.9%	89.0%	51.8%
(12) Auto Phys Damage	J	31.3%*	12.8%*	95.8%	56.9%
(10) Fidelity & Surety	K	29.8%	8.6%	88.9%	31.2%
(13) Other	L	25.7%	10.5%	68.7%	22.6%
(15) International	M	20.5%	1.4%	28.9%	1.9%
(16) Reins Property & Financial	N&P	34.3%	7.7%	63.3%	20.9%
(17) Reinsurance Liab	O	15.9%	4.4%	49.9%	13.8%
(18) Products Liability	R	48.4%	19.7%	75.1%	31.0%
(14) Fin & Mort	S	**	**	**	**
(19) Warranty	T	**	**	**	**
Average		67.1%	31.7%	91.3%	51.6%

*Salvage and subrogation development often produces negative reserves which result in many companies being excluded from the reserve data by the current filter.
** Not enough data
Dollar measure is based on total reserve dollars utilized divided by total reserve dollars for industry
Company measure is based on number of companies utilized divided by total number of Companies
Average is weighted average using 2008 industry data

To measure the effect on risk charges of the filtering in the Current Calibration Method, we tested the effect of an alternative filtering process that eliminates individual data points rather than entire companies.

Exhibit 2 shows the charges that would result from the use of a filter based on the size of the underlying data which targets use of 90% of industry premium dollars or reserve dollars, as appropriate. In the case of the Homeowners/Farmowners line, for example, the alternative filter eliminated all reserve run-off ratio observations where total booked reserves (the denominators of the reserve run-off ratios) are less than $9.4 million for calculating the reserve charges, and eliminated all loss ratios where the earned premium is less than $30.5 million for calculating the premium charges. As a result, 90% of Homeowners/Farmowners industry dollars are used in the calibration calculations (a *decrease* from the Current Calibration Method for premium). Appendix A shows the thresholds and the dollar utilization percents by line of business.

The alternative filter ensures that 90% of industry dollars are used for all lines of business. Filtering by data point also allows data from insolvent, run-off, withdrawn, and new companies to be reflected in the RBC charges.

Lines of Business with Insufficient Data Post-Filter

For International and Financial/Mortgage Guarantee there was not enough data after the Current Filter to calibrate factors. The NAIC judgmentally set the 2010 International charge equal to its previous value prior to application of the IIO. The Financial/Mortgage Guarantee charge was also set equal to its previous value and then increased due to the housing market collapse by the maximum amount allowable under the post-IIO 5%-cap constraint. The Indicated values for these two lines are shown as "N/A" (not available) in column (4) of Exhibit 2.

The Alternative Filter keeps enough data to calibrate factors for International but not for Financial/Mortgage Guarantee.

The "Average" values include no adjustment for loss sensitive business or diversification by line of business. The averages also do not include provision for the other quantities included in the RBC's R4 and R5 calculations – reinsurance (R4 only), excessive premium growth, and A&H business.

Exhibit 2: Effect of Alternative Company Filtering

		Reserving RBC charge				Premium RBC Charge		
(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)
		2010	Current Filter	Alternative Filter		2010	Current Filter	Alternative Filter
Line	Line Letter	Actual	Indicated	Indicated		Actual	Indicated	Indicated
(1) H/F	A	0.127	0.127	0.080		0.169	0.152	0.149
(2) PPA	B	0.106	0.050	0.050		0.171	0.138	0.118
(3) CA	C	0.121	0.121	0.120		0.154	0.099	0.106
(4) WC	D	0.099	0.111	0.092		0.142	0.125	0.111
(5) CMP	E	0.283	0.283	0.214		0.100	0.069	0.055
(6) MM Occurrence	F1	0.238	0.053	0.213		0.672	0.572	0.541
(7) MM CM	F2	0.153	0.156	0.118		0.178	0.392	0.352
(8) SL	G	0.119	0.050	0.100		0.087	0.075	0.066
(9) OL	H	0.287	0.303	0.479		0.125	0.093	0.094
(11) Spec Prop	I	0.151	0.231	0.244		0.168	0.050	0.067
(12) Auto Phys Dam	J	0.085	0.050	0.191		0.094	0.065	0.050
(10) Fidelity & Surety	K	0.246	0.229	0.821		0.073	0.160	0.050
(13) Other	L	0.133	0.115	0.268		0.121	0.119	0.153
(15) International*	M	0.160	N/A	0.155		0.333	N/A	0.270
(16) Reins Property & Financial	N&P	0.159	0.424	0.150		0.480	0.823	0.536
(17) Reinsurance Liability	O	0.482	0.975	0.554		0.446	0.601	0.424
(18) Products Liability	R	0.382	1.030	0.899		0.215	0.272	0.110
(14) Fin & Mort*	S	0.111	N/A	0.111		0.585	N/A	0.585
(19) Warranty**	T	0.246	0.229	0.821		0.073	0.160	0.050
Average		0.201	0.254	0.255		0.155	0.135	0.116

* Not analyzed. Factors judgmentally set. Refer to text.
** Set equal to Fidelity & Surety due to limited data.
Charges are shown after IIO and are subject to the 5% minimum charge.
Average is weighted average using 2008 industry data. For the purpose of averaging, N/As in columns (4) and (5) were replaced by the column (3) value; in columns (7) and (8) by column (6).
Premium RBC charges in this and all other exhibits based on industry average expense ratio of 27.5%.
Note: In this and subsequent exhibits the "2010 Actual" factors reflect the cap on changes in the factors selected by the NAIC to be 5% in 2010. Factors labeled as "indicated" reflect no such caps.

We note that the current filtering was intended to avoid distorting effects due to new companies and run-off companies; we believe the distortions, if any, might not be as large as feared and could be eliminated by other means.

We also note that the current filtering was intended to generate a database of companies that all have the same number of loss ratio observations (ten) and the same number of reserve run-off ratio observations (nine). With alternative filtering that eliminates data points rather than entire companies, companies that remain will have different numbers of years represented in the RBC database. This may be a concern if the distribution of the maturities of the RBC data has a significant impact on the value of the calibrated underwriting risk charge. We did not investigate the impact of data maturity in the current work.

As might be expected, the effect of the alternative filtering is significant for lines in which the volume of data used increased the most. For reserve risk these are Special Property, Auto Physical Damage, Fidelity & Surety, Other, International and Reinsurance Property and Liability—lines where 30% or less of industry reserves are included in the Current Calibration Method. For premium risk, lines with large increases in the volume of data used are Other, International, and Reinsurance Property and Liability—lines where less than 70% of data is used in the Current Calibration Method.

However, there are also changes in lines with smaller—and opposite—differences in total volume used. For example, in Private Passenger Automotive the reserve charge decreased from 0.106 to 0.050 (the smallest charge allowed) with an increase from 85% to 90% in the total volume of reserve data used. The corresponding premium charge decreased from 0.138 to 0.118 (a nearly 20% decrease), but with a decrease from 95.6% to 90% in the total volume of premium data used.

These changes show that the filtering method has a significant impact on the risk charge.

3.1.1 Pools

We also considered the treatment of pooling in the current filtering method. In the Current Calibration Method, pro rata pool participants each record the same values for reserve run-off ratios and loss ratios. This results in duplicate values being counted multiple times, which overstates the impact of a pool on the calibration of the reserve and premium charges. In other cases, this could result in the elimination of an entire pool if participation percentages drop all individual members below the $500,000 minimum premium threshold.[3] An alternative mechanism where each pool, rather than each pool member, is viewed as a single entity would more appropriately reflect the distribution of observed, historical experience. We did not test the effect of aggregating pool representation in our current work.

[3] The risk of potentially excluding all companies in a pool might be more significant with the alternative filtering discussed above than with the current filtering for those lines of business for which the size threshold is larger in the alternative filtering (see Appendix A) than the current threshold ($½ million).

3.2 Risk Charge Measurement

3.2.1 Observed data upon which charges are based

The selected risk charges in the Current Calibration Method are based on the empirical 87.5th percentiles of the filtered data.[4] For the premium charges, the data are loss ratios while for the reserve charges the data are reserve run-off ratios.

Ratio-based data tends to be highly volatile—the smaller the denominator, the greater the expected volatility. In the case of reserve run-off ratios the denominator is booked reserves—thus, the smaller the booked reserve, the greater the expected volatility. The greater volatility of reserve run-off ratios for companies with smaller booked reserves is evident in the graphs of 12/31/2008 RBC reserve run-off ratio data by line of business (see Appendix B). However, the fundamental nature of ratio volatility as a function of the denominator of the underlying is data is not captured in the current RBC formula. The current formula applies the same factor to every company's carried reserve regardless of reserve size, using a factor derived from all companies in the industry. As a result, the dollar amount of capital resulting from the current RBC formula can be expected to understate the indicated dollar charge for companies with smaller booked reserves and overstate the dollar charge for companies with larger booked reserves.

We did not calculate the volatility of 12/31/2008 RBC loss ratio data as a function of earned premium in this short-term project, but we would expect to observe greater loss ratio variability for companies with smaller earned premiums than for companies with greater earned premiums. Subject to verification, the premium component of the RBC underwriting risk calculation is expected to understate the dollar volatility charge for companies with smaller earned premium and overstate the dollar volatility charge for companies with higher earned premiums.

3.2.2 Statistic upon which charges are based

As mentioned above, the selected risk charge in the Current Calibration Method is based on the empirical 87.5th percentile of the filtered data.

High empirical percentiles tend to be highly volatile and can be sensitive to the volatility of the underlying data as well as the number of observations. The volatility of the data underlying the Current Calibration Method of the current RBC formula was addressed in the section above. We next address the number of observations.

We believe that the observed changes in indicated 87.5th percentiles from one RBC calibration cycle to the next was the motivation for instituting caps on changes in the factors (see Section 2.1). For the lines with few observations, the 87.5th percentile of reserve run-off ratios can be especially

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[4] This data includes judgmental selections for some lines along with the above-mentioned caveats on investment income offsets and possible caps on changes in factors.

volatile over time. The number of observations of filtered reserve run-off ratios varies by line of business—with at most approximately 4,000 observations and as few as 20 observations.[5] In Appendix C we show 90% confidence intervals for the "true 87.5th percentile" given the filtered sample of statement year 2008 observations. For almost all lines of business the width of the interval is greater than ±5%, the current cap.. For some lines the width is greater than ±35%, the cap originally recommended by the American Academy of Actuaries.[6] The widths of these confidence intervals leads us to conclude that it is should not be surprising for many lines of business to experience significant changes in RBC factors from one calibration cycle to the next.

It is likely that increasing the number of years of data would reduce the volatility. In Schedule P there are only 9 reserve run-off ratio observations per company; with 20 years of data there would be 19 observations. Also, with more years of data, the effect of the underwriting cycle would more fully be reflected in the data. Increasing the number of years of data could be accomplished by supplementing the current Schedule P with data from older Schedule Ps, with data from special calls, or both. However, even doubling the volume of data may be ineffective in stabilizing the changes in the factors for some lines. We did not test the stabilizing effectiveness of using additional data in this short-term project.

3.2.3 Curve Fitting

Regardless of the number of years of data used, curve fitting could provide an alternative measure of the risk charge compared to relying solely on empirical statistics. We did not investigate the effectiveness of curve fitting in stabilizing the volatility of changes in RBC factors in this short-term project, but we did investigate its impact on specific indicated values. In Exhibits 3 and 4, we demonstrate the effect of curve fitting for factor selection for premium and reserve risk factors, respectively.

The factors in the columns labeled "Percentile Function" (5) are the empirical 87.5th percentile values of the loss ratio and reserve run-off ratio data but using more observations than the Current Calibration Method via the alternative filtering approach discussed above. The factors in the Normal and Lognormal Distribution columns are the 87.5th percentiles from the respective theoretical distributions fit to the line of business loss ratio and reserve run-off ratio data points under the alternative filtering using the method of moments technique.

Assuming no change in the security level (the 87.5th percentile) the industry-wide effects of the alternative filtering and curve fitting for premium and reserve risk are shown in the "Average" rows of Exhibits 3 and 4, respectively.

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[5] Exhibit C-1 in Appendix C shows the number of observations by line of business based on a database that is approximately equivalent to the spreadsheet of data underlying the current calibration calculation.

[6] *An Update to P/C Risk-Based Capital Underwriting Factors: September 2007 Report to the National Association of Insurance Commissioners P/C Risk-Based Capital Working Group*, American Academy of Actuaries' P/C Risk-Based Capital Committee, September 2007, p. 3.

For the premium risk charge (Exhibit 3), column (4) shows the indicated factors under the Current Calibration Method if there were no limits on movements in factors; limiting movements in factors results in an increase in the actual factor used for some lines and a decrease for others. The alternative filter with the current empirical percentile function shown in column (5) indicates a reduction in average charge to 0.116. Indicated (overall) charges based on fitting normal and lognormal curves to the data would be 0.155 and 0.147 (columns (6) and (7), respectively), compared to the current charge of 0.155. Variations are more significant by individual line of business.

Exhibit 3: Premium Risk Charges based on Curve Fitting

			Current Filter	Alternative Filter		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Line	Line Letter	2010 Current	Indicated Current Methodology	Percentile Function	Normal Distribution	Lognormal Distribution
(1) H/F	A	0.169	0.152	0.149	0.232	0.228
(2) PPA	B	0.171	0.138	0.118	0.125	0.126
(3) CA	C	0.154	0.099	0.106	0.153	0.151
(4) WC	D	0.142	0.125	0.111	0.131	0.131
(5) CMP	E	0.100	0.069	0.055	0.096	0.093
(6) MM Occurrence	F1	0.672	0.572	0.541	0.511	0.478
(7) MM CM	F2	0.178	0.392	0.352	0.389	0.369
(8) SL	G	0.087	0.075	0.066	0.097	0.088
(9) OL	H	0.125	0.093	0.094	0.154	0.141
(11) Spec Prop	I	0.168	0.050	0.067	0.140	0.123
(12) Auto Phys Dam	J	0.094	0.065	0.050	0.062	0.063
(10) Fidelity & Surety	K	0.073	0.160	0.050	0.165	0.056
(13) Other	L	0.121	0.119	0.153	0.317	0.281
(15) International	M	0.333	0.333	0.270	0.425	0.378
(16) Reins Property & Financial	N&P	0.480	0.823	0.536	0.576	0.493
(17) Reins Liability	O	0.446	0.601	0.424	0.462	0.426
(18) Products Liability	R	0.215	0.272	0.110	0.233	0.192
(14) Fin & Mort*	S	0.585	0.585	0.585	0.585	0.585
(19) Warranty**	T	0.073	0.160	0.050	0.165	0.056
Average		0.155	0.135	0.116	0.155	0.147

See Notes to Exhibit 2.

Exhibit 4 is similar to Exhibit 3 but addresses the reserve risk charge. The alternative filter with the current empirical percentile function indicates an average charge of 0.255 (column (5)), similar to the indicated charge if movements in factors by line were not limited. If curve fitting were used the indicated overall charges would be higher: 0.318 and 0.305 (columns (6) and (7)), for normal and lognormal curves, respectively. Variations are more significant by individual line of business.

Exhibit 4: Reserve Risk Charges based on Curve Fitting

			Current Filter	Alternative Filter		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Line	Line Letter	2010 Current	Indicated Current Methodology	Percentile Function	Normal Distribution	Lognormal Distribution
(1) H/F	A	0.127	0.127	0.080	0.143	0.143
(2) PPA	B	0.106	0.050	0.050	0.142	0.144
(3) CA	C	0.121	0.121	0.120	0.243	0.242
(4) WC	D	0.099	0.111	0.092	0.100	0.101
(5) CMP	E	0.283	0.283	0.214	0.323	0.316
(6) MM Occurrence	F1	0.238	0.053	0.213	0.290	0.278
(7) MM CM	F2	0.153	0.156	0.118	0.229	0.217
(8) SL	G	0.119	0.050	0.100	0.222	0.214
(9) OL	H	0.287	0.303	0.479	0.513	0.493
(11) Spec Prop	I	0.151	0.231	0.244	0.364	0.341
(12) Auto Phys Dam	J	0.085	0.050	0.191	0.402	0.313
(10) Fidelity & Surety	K	0.246	0.229	0.821	1.131	0.952
(13) Other	L	0.133	0.115	0.268	0.588	0.544
(15) International	M	0.160	0.160	0.155	0.306	0.284
(16) Reins Property & Financial	N&P	0.159	0.424	0.150	0.343	0.319
(17) Reinsurance Liability	O	0.482	0.975	0.554	0.595	0.576
(18) Products Liability	R	0.382	1.030	0.899	0.973	0.902
(14) Fin & Mort*	S	0.111	0.111	0.111	0.111	0.111
(19) Warranty**	T	0.246	0.229	0.821	1.131	0.952
Average		0.201	0.254	0.255	0.318	0.305

See notes to Exhibit 2.

3.3 Investment Income Offset (IIO)

We investigated the sensitivity of the RBC calculation to the assumption of a 5% risk-free rate. In Exhibits 5 and 6, we show the indicated R4 (reserve risk) and R5 (premium risk) factors under alternative discount rate assumptions, prior to application of the 5% minimum charge. For illustration, we base the values on the averages of U.S. Treasuries as of 12/31/2008, 12/31/2009, and 12/31/2010 for three-, five-, and ten-year securities minus a "risk margin" of 0.5%, or 50 basis points. Fifty basis points is not a recommendation but illustrates the application of a risk margin. We note that when the original 5% discount rate was selected in the early 1990s, actual yields on five- and ten-year treasury securities were about 100 basis points higher than the 5% selection.[7] Some working party members suggest that the discount rate could be *higher* than the risk-free rate because a going-concern insurance enterprise is expected to earn more than the risk-free rate.

To maintain a constant safety level in the RBC formula, the discount rate should be updated periodically rather than using a constant value of 5%. Possible alternatives include selecting a rate based on recent short term rates in yield (such as government instruments) for premium, and embedded asset returns for reserves. The rate could vary by line of business, and could be coordinated with the R1 and R2 calibrations (beyond the scope of this working party's charge.)

We note that according to the Center on Federal Financial Institutions in its 2004 discussion of discount rates for the Pension Benefit Guarantee Corporation, "Current law provides for a discount rate based on the average yield of long-term corporate bonds of high credit quality."[8] Thus, the U.S. Treasury recommended both using a discount rate that is higher than the risk-free rate and varying that rate according to the duration of the liability. The issue of a floating rate, however, is also not without controversy (see page 6 of the footnoted report).

As shown in Exhibits 5 and 6, use of a 10-year treasury rate minus 0.5% implies increases in the underwriting factors averaging 32.7% for reserve risk and 30.4% for premium risk – column (7) in the Average row for Exhibits 5 and 6, respectively. Use of the five-year treasury rate minus 0.5% implies increases in the underwriting factors averaging 48.8% for reserve risk and 45.2% for premium risk – column (6) in the Average row.

Payout Pattern

The "IRS Procedure" used in the current formula to determine the payout pattern can introduce unintended payment pattern distortions depending on the line of business. This procedure bases payment patterns on paid-to-date dollars by line from Best's Aggregates and Averages. For Workers Compensation and Reinsurance Liability the payment pattern was extended to 15 years in contrast to the 10 years used by the IRS Procedure. An alternative actuarial procedure could be investigated, but we did not do so in this project.

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7 At the beginning of 1993 five-year treasury notes were yielding 5.90%, ten-year notes 6.60%. See http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yieldYear&year=1993.

8 Elliott, Douglas J., "PBGC: A Yield Curve Primer", Sep. 10, 2004, http://www.coffi.org/pubs/Primer%20on%20Yield%20Curve%205.pdf.

Exhibit 5: Indicated R4 (Reserve) Factors Under Selected Discount Rates

		Discount rate *				Percentage difference		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Line of Business	Line Letter	Current 5.00%	3 year 0.74%	5 year 1.58%	10 year 2.63%	0.74%	1.58%	2.63%
(1) H/F	A	0.127	0.189	0.176	0.160	49.4%	39.0%	26.5%
(2) PPA	B	0.043		0.097	0.079		124.1%	83.9%
(3) CA	C	0.121		0.193	0.169		59.8%	40.3%
(4) WC	D	0.111		0.257	0.208		132.3%	88.2%
(5) CMP	E	0.283		0.402	0.363		41.8%	28.1%
(6) MM Occ	F1	0.053		0.160	0.125		203.4%	136.6%
(7) MM CM	F2	0.156		0.256	0.224		64.5%	43.6%
(8) SL	G	0.036		0.120	0.092		232.5%	156.7%
(9) OL	H	0.303		0.449	0.400		48.3%	32.3%
(11) Spec Prop	I	0.231	0.267	0.260	0.250	15.9%	12.6%	8.6%
(12) Auto Phy Dam	J	-0.024	-0.004	-0.008	-0.013	-84.6%	-67.2%	-45.9%
(10) Fidelity & Surety	K	0.229	0.295	0.281	0.264	28.9%	22.9%	15.6%
(13) Other	L	0.115	0.147	0.141	0.133	28.1%	22.5%	15.6%
(15) International	M	0.160		0.268	0.232		67.7%	45.3%
(16) Reins Property & Financial	N&P	0.424		0.514	0.485		21.4%	14.5%
(17) Reins Liability	O	0.975		1.222	1.141		25.4%	17.0%
(18) Products Liability	R	1.030		1.279	1.197		24.2%	16.2%
(14) Fin & Mort	S	0.065		0.122	0.104		87.7%	60.0%
(19) Warranty		0.229		0.281	0.264		22.9%	15.6%
Average		0.252		0.376	0.335		48.8%	32.7%

Factors are based on three-year treasury rates not shown for the longer tailed lines of business.
Average is 2008-reserve-weighted average.
Factors are indicated prior to application of the 5% minimum charge, as that would distort the measurement of the stand-alone effect of the change in interest rate assumption.

Exhibit 6: Indicated R5 (Premium) Factors Under Selected Discount Rates

		Discount rate *				Percentage difference		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Line of Business	Line Letter	Current 5.00%	3 year 0.74%	5 year 1.58%	10 year 2.63%	0.74%	1.58%	2.63%
(1) H/F	A	0.152	0.187	0.180	0.171	23.5%	18.6%	12.7%
(2) PPA	B	0.138		0.184	0.170		33.7%	22.9%
(3) CA	C	0.099		0.166	0.144		67.4%	45.5%
(4) WC	D	0.125		0.229	0.194		83.6%	55.6%
(5) CMP	E	0.069		0.129	0.109		87.0%	58.3%
(6) MM Occ	F1	0.572		0.825	0.741		44.3%	29.5%
(7) MM CM	F2	0.392		0.544	0.494		38.8%	26.0%
(8) SL	G	0.075		0.134	0.115		79.0%	53.1%
(9) OL	H	0.093		0.212	0.172		126.8%	84.3%
(11) Spec Prop	I	0.021	0.055	0.048	0.039	161.6%	128.2%	87.4%
(12) Auto Phy Dam	J	0.065	0.085	0.081	0.076	30.6%	24.5%	16.9%
(10) Fidelity & Surety	K	0.160	0.239	0.223	0.203	49.4%	39.1%	26.7%
(13) Other	L	0.119	0.159	0.151	0.141	33.6%	26.8%	18.4%
(15) International	M	0.333		0.405	0.381		21.7%	14.5%
(16) Reins Property & Financial	N&P	0.823		0.945	0.905		14.8%	10.0%
(17) Reins Liability	O	0.601		0.842	0.760		40.3%	26.6%
(18) Products Liability	R	0.272		0.458	0.395		68.4%	45.3%
(14) Fin & Mort	S	0.513		0.620	0.586		21.0%	14.3%
(19) Warranty		0.160		0.223	0.203		39.1%	26.7%
Average		0.133		0.193	0.173		45.2%	30.4%

Factors are based on three-year treasury rates not shown for the longer tailed lines of business.
Average is 2008-Net Written Premium-weighted average.
Factors are indicated prior to application of the 5% minimum charge, as that would distort the measurement of the stand-alone effect of the change in interest rate assumption.

3.4 Observations Regarding Solvency II[9]

In the course of our work, we considered certain features of the Solvency II Standard Formula[10] as they compare to RBC.

3.4.1 Quantitative Assessment of Required Capital

Solvency II prescribes a formulaic calculation of the required solvency capital, which all companies may adopt. This is called the Standard Formula.

Alternatively, a company can develop its own model (internal model) or calibrate the parameters of the standard formula so that they are more appropriate for that company (partial internal model). The use of internal models or partial internal models is subject to regulatory approval.

Our work focused on the Standard Formula.

3.4.2 Own-Risk Solvency Assessment (ORSA)

In addition to the required solvency capital assessment, Solvency II requires a self-assessment of the economic capital required to run the business (own-risk solvency assessment or ORSA). This includes a qualitative assessment of risk, which examines an entity's exposure to various risk factors and discusses the risk management processes in place at the company.

Our work focused on the Standard Formula, and not on ORSA.

3.4.3 Calibration of the Standard formula

In the case of Solvency II, calibration of parameters uses data provided voluntarily, as a full set of industry data is not available as it is in the U.S.

The promulgators of Solvency II examined several statistical approaches to calibrate the standard parameters, and these were augmented by expert judgment.

3.4.4 Alternate Valuation of Technical Provisions (Loss Reserves)

Under Solvency II, loss reserves are evaluated on a discounted basis. An explicit margin, termed a risk margin, is incorporated into the valuation.

RBC is part of U.S. statutory financial reporting, so loss reserves are normally[11] presented on the balance sheet on an undiscounted basis. Within the RBC system, however, there is credit for

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[9] This section discusses only certain features of Solvency II as those relate to RBC. The discussion is not a complete analysis of Solvency II and is not a complete comparison of RBC to Solvency II.

[10] https://eiopa.europa.eu/fileadmin/tx_dam/files/consultations/QIS/QIS5/Spreadsheets&IT-Tools/10.06-update/QIS5-V6-20101006.xls

[11] Certain exceptions exist for workers compensation line of business and other cases with permission by state regulators.

investment income in the risk charge (through the investment income offsets). Therefore, while expressed differently, both RBC and Solvency II measure capital adequacy on a discounted basis, but RBC does not include an explicit risk margin.

3.4.5 Risk Horizon: One-Year versus Full Run-off

In the Standard Formula, Solvency II calibrates the reserve risk charge to the risk so that the reserve, including risk margin, one year after the valuation date will be higher than was predicted at the valuation date. This is referred to as a one-year time horizon.

We understand that RBC intends to calibrate the reserve risk charge to the risk such that ultimate claim payouts, when all claims are settled, will be higher than predicted at the valuation date. This is referred to as a run-off time horizon.

In Exhibit 7, we present the results of applying the calibration procedures discussed in section 3.2 on a one-year basis and a run-off basis. Columns (3) and (4) show the 2010 RBC charges and the charges indicated by the Current Calibration Method, the same as the values in Exhibit 2. The averages for all lines of business combined are .201 and .254, respectively.

Column (5) shows the results of applying a one-year, run-off time horizon rather than a run-off time horizon using the 87.5th percentile approach and the current filter. The average for all lines of business is .071, compared to the .254 in Column (4) which is same approach but with a run-off time horizon. Columns (6) and (7) show the one-year and run-off time horizons using the alternative filter and 87.5th percentile approaches. These values, averaged for all lines of business are .255 and .058. The effect of using the one-year time horizon, at either the 87.5th or 95th percentile safety levels, is a reduction in the overall reserve risk charge and in the risk charge for long-tailed lines compared to short-tailed lines.

Columns (8) – (10) show the one-year time horizon charge with a higher safety margin, 95% rather than 87.5%, and use three approaches to measure the charge—the empirical approach, the fitted normal distribution, and the fitted lognormal distortion—which are comparable to the alternative approaches shown in Exhibit 3. A higher safety level for the RBC result might be considered an offset to the fact that the one-year time horizon, when applied in Solvency II, is applied to an accounting system that includes a risk margin in reserves while RBC does not. We have not considered whether the 95th percentile is an appropriate safety level for the risk margin.

The effect of the using the one-year time horizon—even at 95th percentile safety levels—is a reduction in the overall reserve risk charge and in the risk charge for long-tailed lines compared to short-tailed lines. This is shown in comparing columns (4) and (7) (at the 87.5th percentile) or columns (8) and (10) (at the 95th percentile).

Exhibit 7: Alternative Reserve Charges Under Current Multi-Year and One-Year Horizons

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Filter		2010 Current	Indicated	Current	Alt	Alt	Alt	Alt	Alt
Safety Level				87.5	87.5	87.5	95	95	95
Empirical/Curve Fit				Empirical	Empirical	Empirical	Empirical	Normal	Log Normal
Time Horizon				One Yr	Runoff	One Yr	One Yr	One Yr	One Yr
(1) H/F	A	0.127	0.127	0.050	0.080	0.050	0.158	0.201	0.228
(2) PPA	B	0.106	0.050	0.050	0.050	0.050	0.050	0.089	0.098
(3) CA	C	0.121	0.121	0.050	0.120	0.050	0.116	0.135	0.150
(4) WC	D	0.099	0.111	0.050	0.092	0.050	0.050	0.050	0.050
(5) CMP	E	0.283	0.283	0.050	0.214	0.050	0.096	0.142	0.162
(6) MM Occurrence	F1	0.238	0.053	0.050	0.213	0.050	0.214	0.225	0.260
(7) MM CM	F2	0.153	0.156	0.050	0.118	0.050	0.142	0.157	0.182
(8) SL	G	0.119	0.050	0.050	0.100	0.050	0.166	0.266	0.307
(9) OL	H	0.287	0.303	0.050	0.479	0.050	0.078	0.158	0.183
(11) Spec Prop	I	0.151	0.231	0.164	0.244	0.147	0.351	0.451	0.523
(12) Auto Phys Dam	J	0.085	0.050	0.059	0.191	0.075	0.278	0.446	0.552
(10) Fidelity & Surety	K	0.246	0.229	0.242	0.821	0.358	0.683	1.023	1.172
(13) Other	L	0.133	0.115	0.157	0.268	0.157	0.291	0.415	0.471
(15) International	M	0.160	0.160	0.053	0.155	0.130	0.301	0.377	0.436
(16) Reins Property & Financial	N&P	0.159	0.424	0.135	0.150	0.086	0.298	0.290	0.337
(17) Reins Liability	O	0.482	0.975	0.191	0.554	0.050	0.180	0.269	0.310
(18) Products Liability	R	0.382	1.030	0.196	0.899	0.103	0.424	0.396	0.456
(14) Fin & Mort*	S	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111
(19) Warranty	T	0.246	0.229	0.242	0.821	0.358	0.683	1.023	1.172
Average		0.201	0.254	0.071	0.255	0.058	0.116	0.161	0.183

See notes to Exhibit 2.

3.5 Pro Forma Ratios: Premium to Company Action Level (CAL) Underwriting RBC Ratios

In this section we show the implications of the discussions in prior sections in terms of Pro Forma Premium to CAL Underwriting RBC Ratios. To calculate these ratios, premium is divided by a consolidated (using the covariance rules) R4 and R5 underwriting charge at the Company Action Level (CAL). These ratios are loosely equivalent to a "premium to minimum required surplus ratio." We note that although these ratios are calculated using the minimum risk-based capital that triggers a company action requirement to the regulator—100% of RBC or 200% of the Authorized Control

Level (ACL)—the industry and most companies operate at surplus levels well in excess of these minimum thresholds.

The Pro Forma Premium to CAL Underwriting RBC Ratio is the reciprocal of the "pro forma underwriting RBC factor" for each line (see Appendix E for proforma underwriting RBC factors).

3.5.1 Ratios Based on the Current Charges

Exhibit 8 shows the separate premium and reserve charges, the pro forma underwriting RBC factors, and the corresponding Pro Forma Premium to Company Action Level (CAL) Underwriting RBC Ratios.

The pro forma underwriting RBC factor is 0.305 for all lines combined, as shown in the Average/Total row of column (9). The current RBC structure and factors indicate that the dollar amount of surplus that the industry must carry for underwriting risk to reach the Company Action Level (defined in Appendix D) is a factor of 0.305 times total premium. This corresponds to a premium to required surplus ratio of 328%, or $3.28 of premium for each dollar of surplus. At the Authorized Control Level, the RBC ratio is halved or 153% and the premium to surplus ratio is doubled or 656%. Among the lines of business that constitute more than 5% of premium or reserves, the charges are lowest for the PPA and Special Property lines and highest for Reinsurance Liability and Other liability (Other Liability is much lower than Reinsurance Liability).

Exhibit 8: Premium Charge versus Reserve Charge – Consolidated RBC Charge

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Line	Line Letter	Current Reserving RBC Charge	Current Premium RBC Charge	Loss & LAE Reserves 2008	Net Written Premium 2008	Reserve Charge	Prem Charge	Pro forma RBC Factor	Prem/ CAL Ratio
(1) H/F	A	0.127	0.169	$ 22.3	$ 59.0	$ 2.8	10.0	0.176	570%
(2) PPA	B	0.106	0.171	87.3	94.5	9.3	16.2	0.197	507%
(3) CA	C	0.121	0.154	26.5	17.8	3.2	2.7	0.237	423%
(4) WC	D	0.099	0.142	130.8	39.5	12.9	5.6	0.357	280%
(5) CMP	E	0.283	0.100	38.7	30.2	11.0	3.0	0.377	265%
(6) MM Occ	F1	0.238	0.672	10.9	2.0	2.6	1.4	1.438	70%
(7) MM CM	F2	0.153	0.178	18.4	7.3	2.8	1.3	0.425	235%
(8) SL	G	0.119	0.087	7.5	6.2	0.9	0.5	0.169	592%
(9) OL	H	0.287	0.125	126.0	40.2	36.2	5.0	0.909	110%
(11) Spec Prop	I	0.151	0.168	16.4	33.5	2.5	5.6	0.184	545%
(12) Auto Phys Dam	J	0.085	0.094	5.7	70.1	0.5	6.6	0.094	1066%
(10) Fidelity&Surety	K	0.246	0.073	4.9	6.1	1.2	0.4	0.208	480%
(13) Other	L	0.133	0.121	0.0	3.6	0.0	0.4	0.121	829%
(15) International	M	0.160	0.333	0.5	0.3	0.1	0.1	0.424	236%
(16) Reins Property & Financial	N&P	0.159	0.480	7.9	6.7	1.2	3.2	0.515	194%
(17) Reins Liability	O	0.482	0.446	40.1	7.2	19.4	3.2	2.728	37%
(18) Products Liability	R	0.382	0.215	16.6	2.8	6.4	0.6	2.297	44%
(14) Fin & Mort*	S	0.111	0.585	0.1	0.6	0.0	0.3	0.585	171%
(19) Warranty**	T	0.246	0.073	0.2	2.1	0.1	0.2	0.077	1291%
Average / Total		0.201	0.155	$560.8	$429.5	$112.9	66.4	0.305	328%

See notes to Exhibit 2.
Columns (5)-(7): billions of dollars
Column (9) = Square root (Column (7) squared plus Column (8) squared)/Column (6)
Column (10) = 1/Column (9)

3.5.2 Ratios Based on Alternative Charges

We observe in Exhibit 8 that the current RBC formula produces smaller charges for premium relative to reserves for many lines of business. This affects all companies, but, in particular, new companies with no reserves at start-up will have a lower RBC requirement than comparable mature companies under the current formula. This premium/reserve risk charge relativity changes significantly under alternative approaches.

In Exhibit 9, we compare the current Pro Forma Premium to CAL Underwriting RBC Ratios from

Exhibit 8 column (10) with those implied by RBC charges under alternative approaches discussed earlier in this report. The pro forma premium to RBC underwriting risk ratios are reasonable statistics to consider, by line and for the industry overall, when investigating alternatives to the current RBC formula.

An explanation of the contents of Exhibit 9 follows, phrased here in terms of the dollar amount of premium supported by a dollar of surplus and illustrated based on the average in the Average/Total row.

Run-off Basis – Columns (3) - (7)

Col (3) Overall, $3.28 of premium can be supported per $1 of surplus (same values as shown in Exhibit 8) based on the current RBC parameters.

Col (4) The *indicated* factors using current filtering and the empirical 87.5th percentile risk charge, before capping parameter swings and without a change in the IIO discount rate, suggest that $2.79 of premium can be supported per $1 of surplus overall.

Col (5) Indicated with alternative filter and 87.5th percentile: $2.84 can be supported.

Col (6) Indicated with alternative filter and curve fitting using a normal distribution: $2.26.

Col (7) Column (6) but using lognormal distribution: $2.36.

One-Year Basis – Columns (8) - (11)

Col (8) Under the Alternative Filter and the one-year time horizon approach described above, the empirical 87.5th percentile indicates that $7.23 of premium can be supported per $1 of surplus overall.

Col (9) Column (8) at the 95 percentile: $3.37.

Col (10) Column (9) but using a normal distribution rather than empirical percentile: $3.05.

Col (11) Column (10), using the lognormal rather than normal distribution: $2.65.

Exhibit 9 is calculated as the reciprocal of Exhibit E (Appendix E) in the same way that in Exhibit 8 column (10) is the reciprocal of column (9).

Exhibit 9: Premium to CAL Underwriting RBC Ratios

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Filter		2010 Cur	Indicated	Alt	Alt	Alt	Alt	Alt	Alt	Alt
Safety Level				87.5	87.5	87.5	87.5	95	95	95
Empirical/Curve Fit				Emp	Norm	Log Norm	Emp	Emp	Norm	Log Norm
Risk Horizon				Runoff	Runoff	Runoff	Rsrv: One Yr, Prem: Runoff	Rsrv: One Yr, Prem: Runoff	Rsrv: One Yr, Prem: Runoff	Rsrv: One Yr, Prem: Runoff
(1) H/F	A	570%	629%	658%	420%	427%	666%	338%	281%	246%
(2) PPA	B	507%	687%	791%	551%	547%	791%	544%	515%	481%
(3) CA	C	423%	488%	483%	255%	257%	771%	317%	312%	274%
(4) WC	D	280%	259%	308%	281%	279%	502%	347%	363%	330%
(5) CMP	E	265%	270%	357%	235%	240%	1188%	431%	374%	317%
(6) MM Occurrence	F1	70%	157%	79%	61%	64%	166%	71%	72%	62%
(7) MM CM	F2	235%	180%	217%	144%	152%	268%	145%	146%	127%
(8) SL	G	592%	1033%	720%	347%	362%	1111%	343%	259%	219%
(9) OL	H	110%	105%	66%	62%	64%	547%	256%	175%	150%
(11) Spec Prop	I	545%	809%	728%	441%	482%	1015%	300%	285%	236%
(12) Auto Phys Dam	J	1066%	1526%	1912%	1435%	1480%	1986%	1000%	800%	702%
(10) Fidelity & Surety	K	480%	413%	153%	109%	132%	346%	137%	112%	97%
(13) Other	L	829%	842%	654%	316%	356%	654%	305%	203%	172%
(15) International	M	236%	236%	270%	152%	167%	291%	97%	113%	98%
(16) Reins Property & Financial	N&P	194%	104%	177%	142%	161%	183%	89%	112%	97%
(17) Reins Liability	O	37%	18%	32%	30%	31%	197%	77%	61%	53%
(18) Products Liability	R	44%	16%	19%	17%	19%	160%	39%	42%	36%
(14) Fin & Mort*	S	171%	171%	171%	171%	171%	171%	171%	171%	171%
(19) Warranty	T	1291%	618%	1019%	496%	888%	1610%	202%	265%	225%
Average		328%	279%	284%	226%	235%	723%	337%	305%	265%

See notes to Exhibit 2.

Exhibit E shows further examples of the pro forma underwriting ratio under alternative safety margins and reserve time horizon combinations.

The premium/reserve risk relativity deserves further study, including consideration of alternatives to the current approach for new companies.

4. CONCLUSIONS AND AREAS OF FURTHER RESEARCH

The URWP found that the current formula is too restrictive to support the determination of risk-responsive capital amounts by company.

Our short-term work identified potential improvements to the Current Calibration Method that could be researched within the framework of the current RBC formula:

Data

1. Filtering strategies.
2. Additional or extended (number of years) data sources.
3. Improved treatment of data from pooled companies.
4. Analysis of the extent to which alternative filtering is affected by run-off and startup companies, and including procedures mitigating that affect, if any.

Analysis

5. Curve fitting procedures.
6. Change in interest discount for IIO.
7. Changes to the (IRS) method for calculating the payment pattern used to determine IIO.
8. Evaluation of better methods to reflect RBC for new companies showing little reserve risk, even though that is temporary.

In addition to the points noted above, our investigation into risk charge measurement procedures raised other questions that could be subjects of longer-term study.

9. Does serial correlation within each company's nine reserve development ratios impact the predictive ability and the swing in the 87.5th percentile-based charges?
10. Would percent of ultimate paid be a better indicator of future development potential than total carried reserves?
11. Should the reserve risk factor be based on exposure measures such as premium, other than, or in addition to, carried reserves?
12. As an enhancement to the alternative filtering illustrated above, could the RBC factors be calibrated from a weighted average of companies' AY development, particularly for companies with less than ten accident years of experience?
13. Should the RBC reserve charge be a function of accident year development rather than a function of total reserve development?
14. Reserve charges are not calibrated to run-off, but rather to a combination of multi-year time

horizons—nine years, eight years, and so forth. If the measurement objective is run-off, can the calibration be more closely aligned with that objective?

15. The current practice of capping data points (section 2.1) has some undesirable consequences: it limits the variability of the data underlying the empirical percentile calculations, potentially understating the line of business charges for the industry as a whole, and it affects the ability to apply curve-fitting. Is there a more robust way to handle outliers in the data?
16. We find that the NAIC de minimus test instructions are ambiguous (see PR017, Line 02).[12] Is there a way to clarify these instructions? This issue may be irrelevant under the alternative filtering discussed in this report where data points rather than entire companies are filtered out.

Additional questions raised by the URWP include:

17. RBC and the Underwriting Cycle: The underwriting cycle and RBC parameter estimates appear to be related, evidenced by apparent correlation in industry reserve development by line, prompting two questions:
    a. Could RBC parameter calibration be improved by explicitly accounting for the underwriting cycle?
    b. Do changes in the RBC parameters impact the underwriting cycle?
18. Are the discounts for direct (30%) and assumed (15%) loss sensitive business appropriate?
19. Risk Measures: Would the purpose of RBC be better served by a risk measure other than value at risk (VaR), e.g., Tail Value at Risk (TVaR) or Expected Policyholder Deficit (EPD)?[13] What should the theoretical basis for any particular security level (e.g., "worst case" or the 87.5 percentile)?
20. Has the formula been a reliable indicator of company trouble or insolvency?
21. Does the formula result in a reasonable total risk charge for the industry as compared to other industries (e.g., banking)?

---

[12] The NAIC RBC instructions for 2010, pp. 21-22, contain the following two sentences:
(1) "If more than one year's net earned premium is less than 20 percent of the average net earned premium, a company is not eligible for an experience adjustment and Row 02 is set equal to Row 01." That means that nine out of 10 or 10 out of 10 years must have NEP greater than 20% of the average NEP for the company to be eligible for an experience adjustment.
(2) "If less than eight years' net earned premiums are greater than 20 percent of the average net earned premium, a company is not eligible for an experience adjustment and Row 02 is set equal to Row 01." That means that, additionally, if eight out of 10 years have NEP greater than 20% of the average NEP the company would be eligible for an experience adjustment.

[13] A research paper on the subject is under development by the CAS Risk-Based Capital Dependencies Working Party.

Acknowledgment

The authors acknowledge the help of CAS staff, especially David Core, Karen Sonnet, and Cheri Widowski.

Appendix A

Exhibit A-1: Alternative filtering – 90% of Industry Targeted

Figures in '000						
Line	**Line Letter**	**% of Industry Reserves**	**Reserve Threshold**		**% of Industry Premium**	**Premium Threshold**
(1) H/F	A	90.00%	9,434		90.00%	30,562
(2) PPA	B	90.10%	51,414		90.00%	60,000
(3) CA	C	90.00%	16,519		89.90%	11,942
(4) WC	D	90.10%	100,771		89.90%	34,257
(5) CMP	E	90.00%	21,830		90.00%	18,026
(6) MM Occurrence	F1	90.00%	37,497		90.00%	8,046
(7) MM CM	F2	90.00%	34,978		90.10%	14,060
(8) SL	G	90.00%	11,419		90.00%	12,655
(9) OL	H	90.10%	65,884		90.00%	22,183
(11) Spec Prop	I	90.10%	10,381		90.10%	12,778
(12) Auto Phys Damage	J	90.10%	13,315		90.10%	37,487
(10) Fidelity & Surety	K	90.00%	13,040		90.00%	7,932
(13) Other	L	90.00%	15,936		90.10%	26,473
(15) International	M	90.00%	4,950		90.00%	4,849
(16) Reins Property & Financial	N&P	90.00%	28,712		90.00%	23,964
(17) Reinsurance Liab	O	90.00%	130,409		90.00%	53,534
(18) Products Liability	R	90.10%	23,719		90.00%	4,202
(14) Fin & Mort*	S	***	***		***	***
(19) Warranty	T	***	***		***	***

*** Not enough data

Note: The uniform 90% rule is illustrative. In practice we recommend research to consider whether the targeted premium/reserve standard is appropriate for each line and to address concerns arising from the elimination of data points rather than companies.

Appendix B: Graphs of reserve run-off ratios vs. carried reserves

The RBC reserve charge is determined by a statistic (the 87.5th percentile) from the reserve run-off ratio (RRR) data discussed above.[14] In Exhibit B we display RRR data by RBC line of business on the y-axis and the carried reserves (the denominators of the RRRs) on the x-axis.

We also show a superimposed regression line. For most RBC lines of business (RBCLOBs), the regression line is horizontal and goes through the origin. These characteristics imply that industry carried reserves in that RBCLOB are unbiased, and that conclusion does not depend on the size of a company's booked reserves. Notable exceptions include APD, which is over-reserved on average (most of the observations are above the x-axis), and Reinsurance Liability and Products Liability, which appear under-reserved on average (most of the observations are below the x-axis).

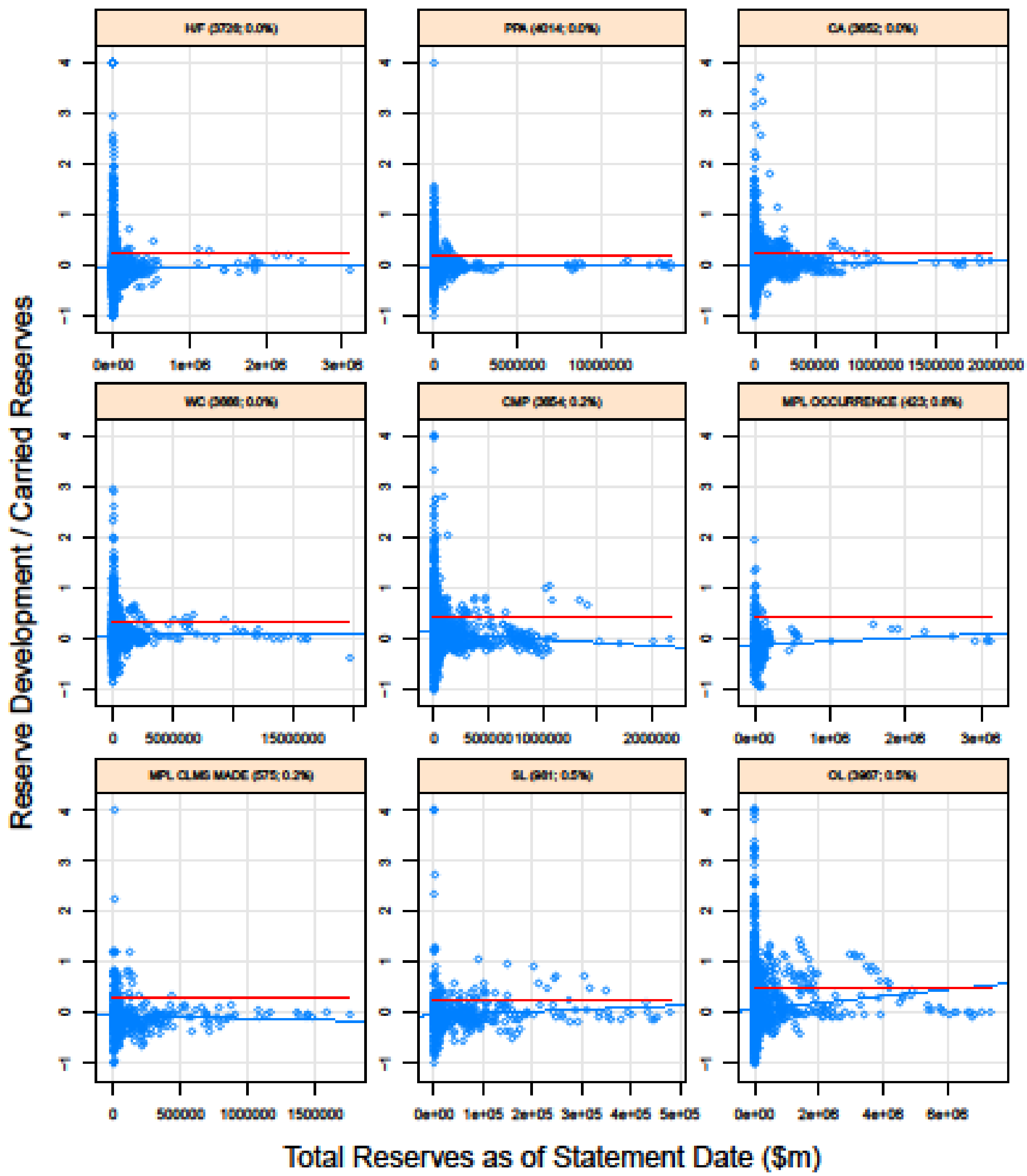
With limited exceptions, reserve run-off ratio volatility appears to decrease as companies' carried reserves increase. This is not unexpected; the carried reserve amount forms the denominator of the RRR, implying that smaller carried reserves will lead to higher ratios. However, this result is contrary to what would be desirable in an RBC factor-based approach. Changes that could address this inconsistency include:

- Change the functional relationship between volatility and carried reserves to be something other than a simple factor (e.g., change the factor based on the size of the carried reserve).
- Use a base other than or in addition to carried reserves (e.g., premium) could be investigated as a potential predictor of reserve development volatility.

[14] The data utilized was compiled using unaudited database queries and varies somewhat from that found in the NAIC's spreadsheets. We do not expect the differences to have significant impact on the results below.

Capped Reserve Runoff Ratios vs. Carried Reserves By RBC Line of Business Current Statement Year: 2008

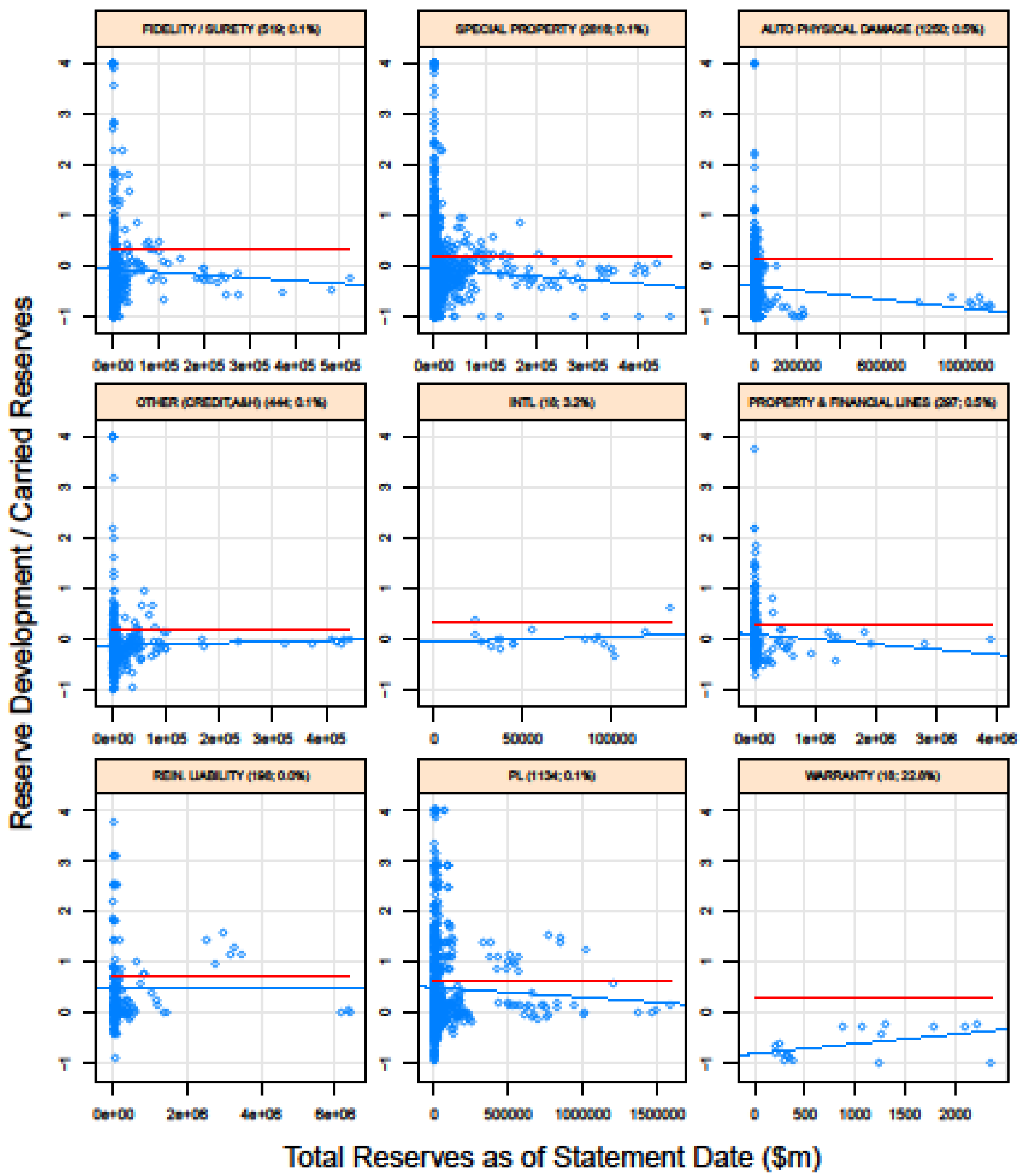
Exhibit B.1
Page 1 of 2



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

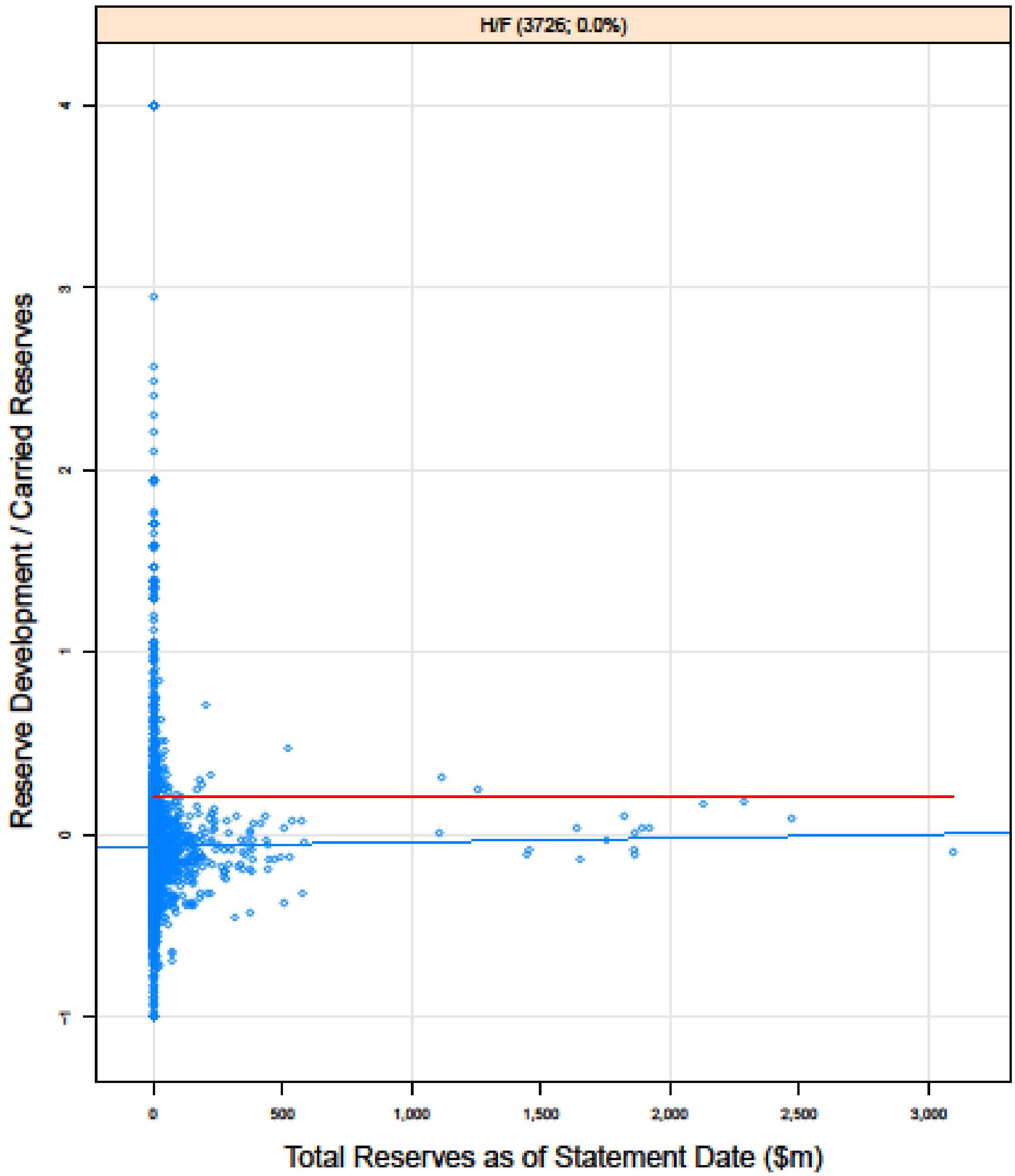
Exhibit B.1
Page 2 of 2



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

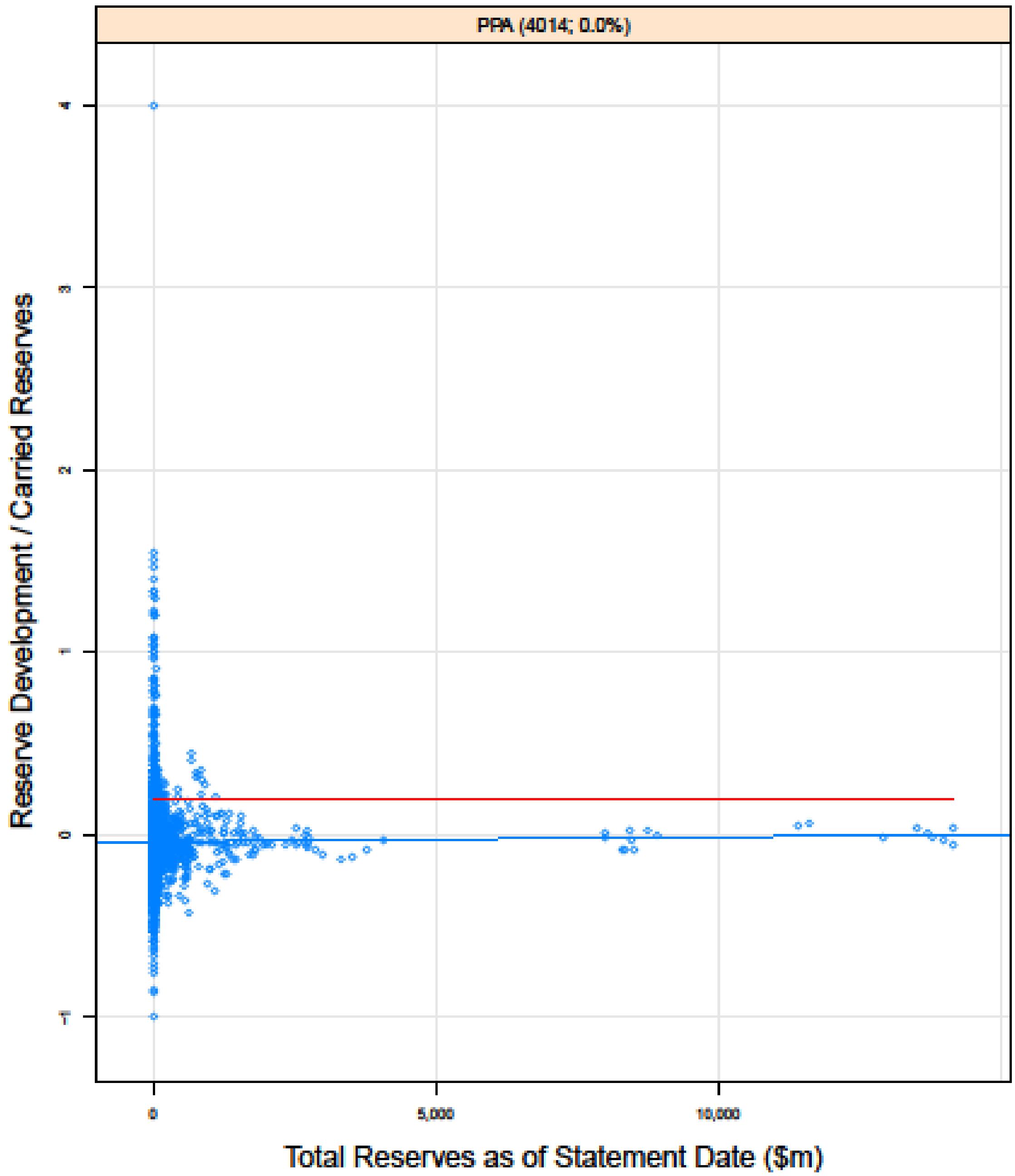
Exhibit B.2
Page 1 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

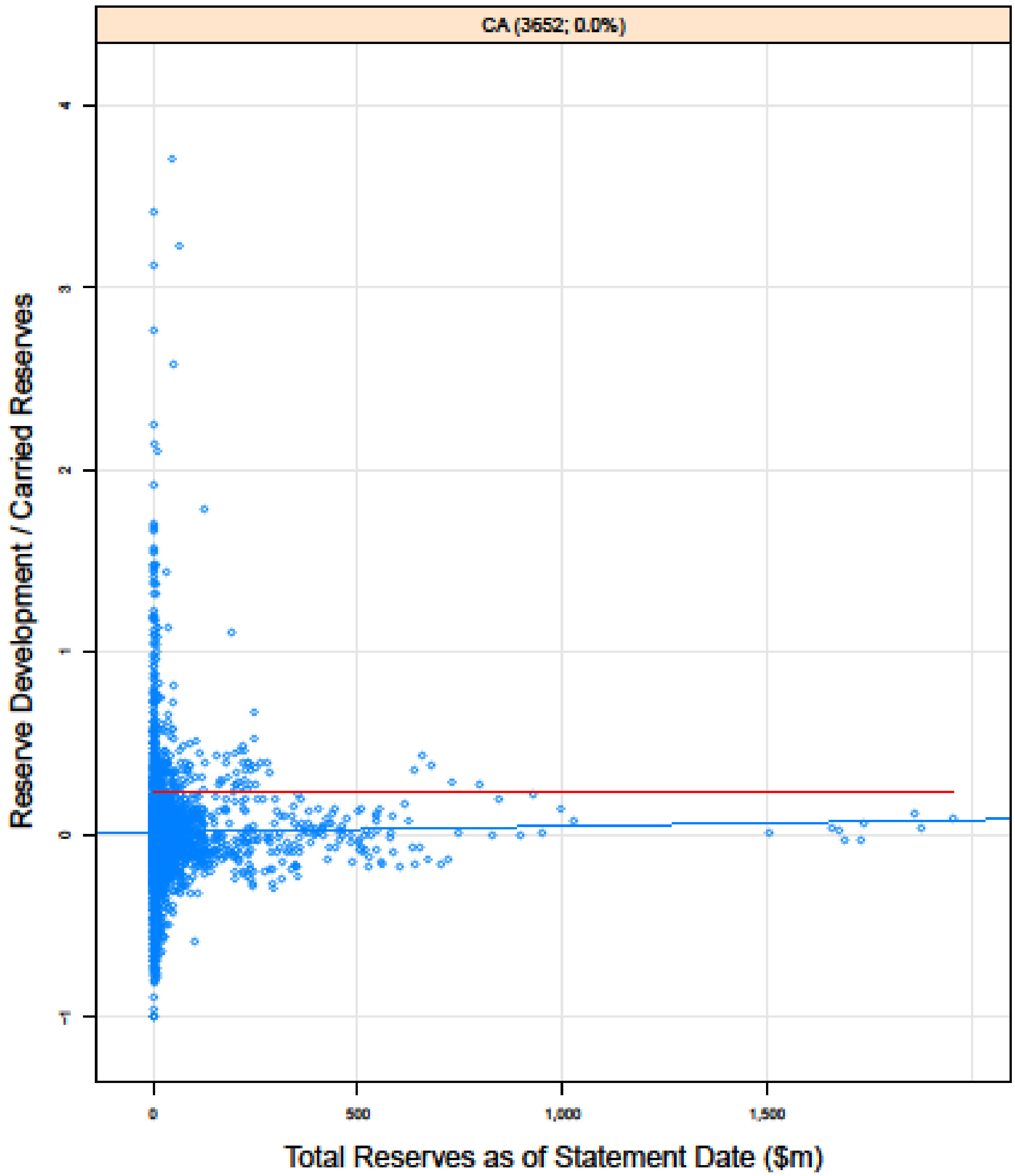
Exhibit B.2
Page 2 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

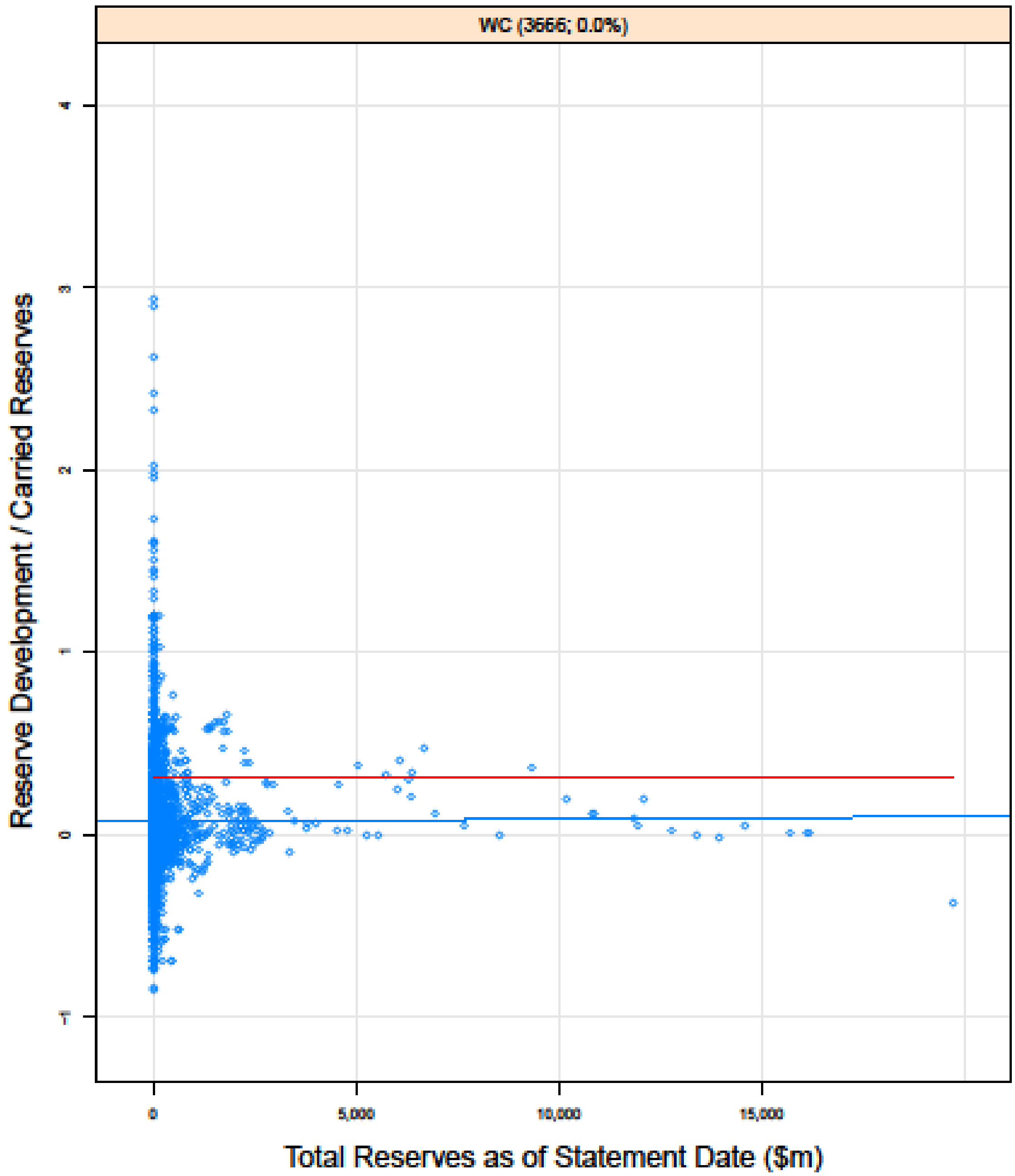
Exhibit B.2
Page 3 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

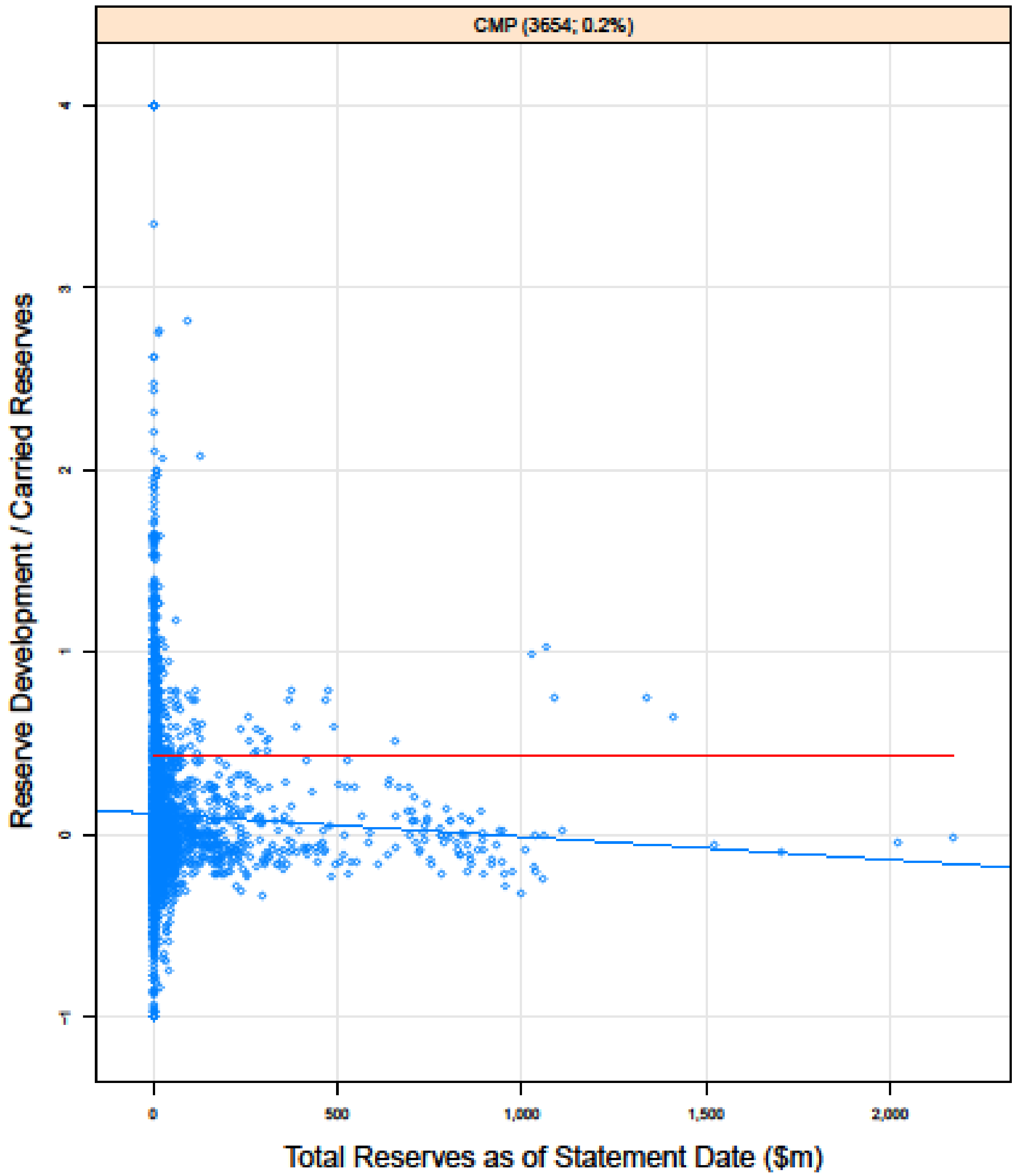
Exhibit B.2
Page 4 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

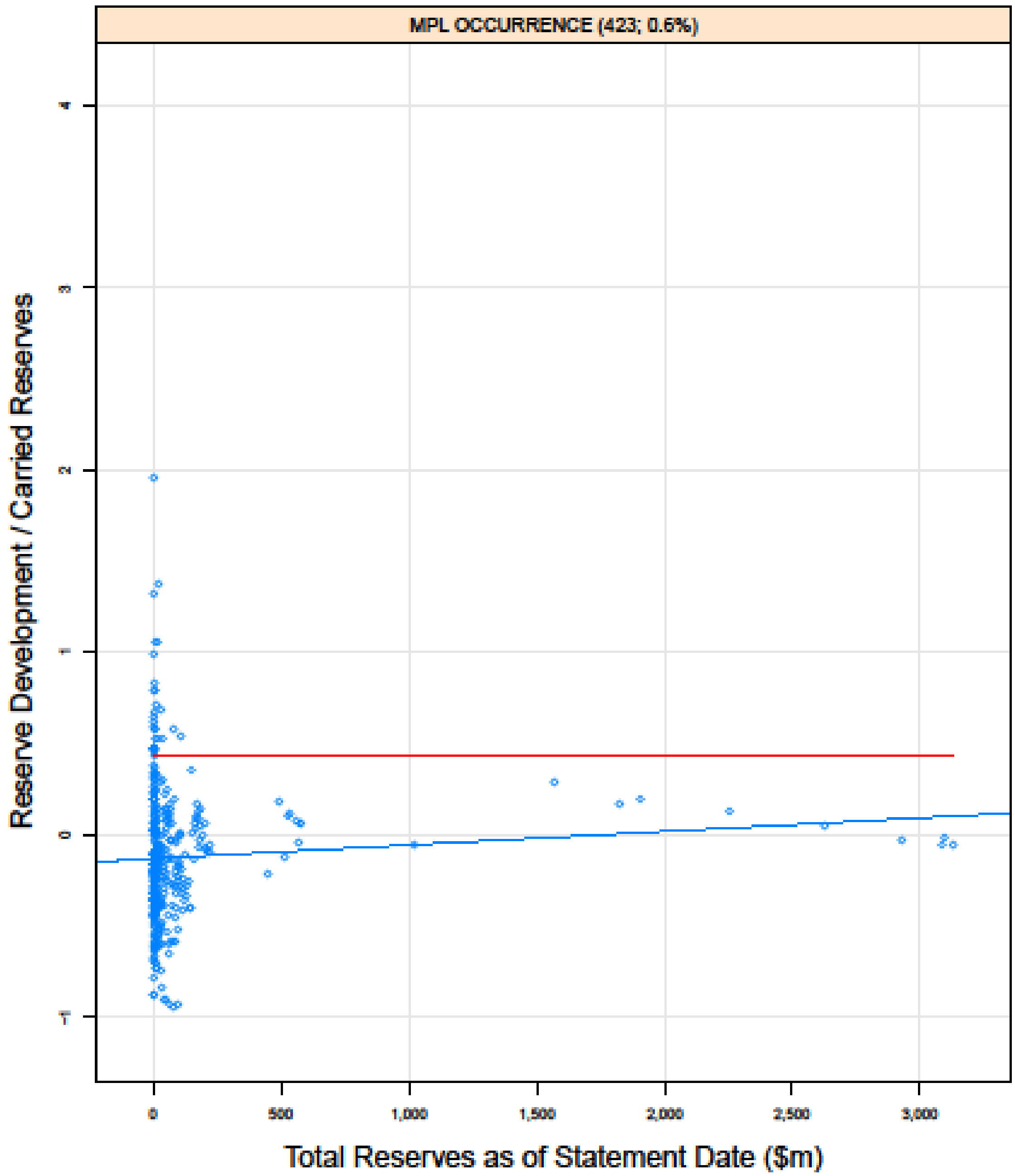
Exhibit B.2
Page 5 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

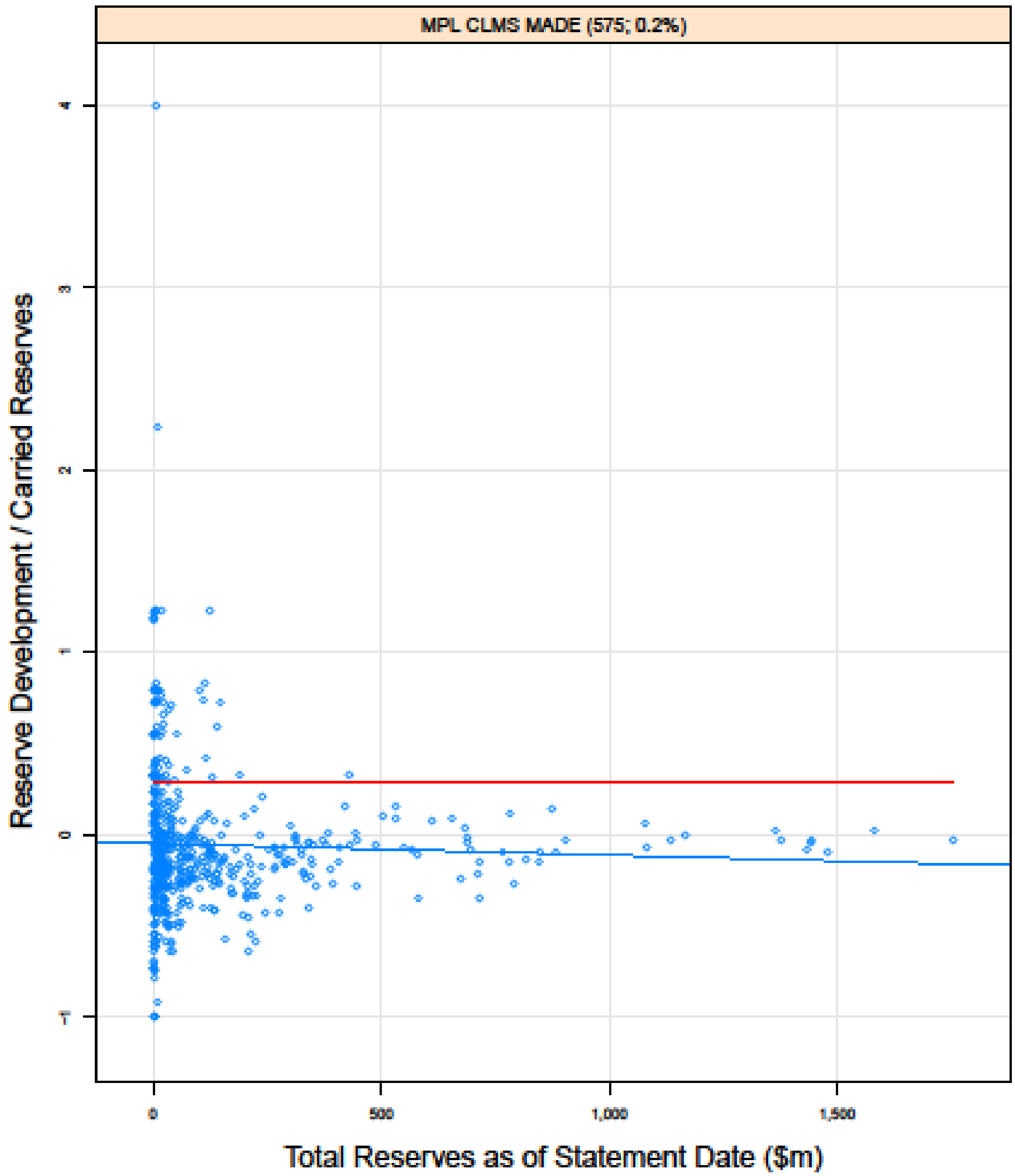
Exhibit B.2
Page 6 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

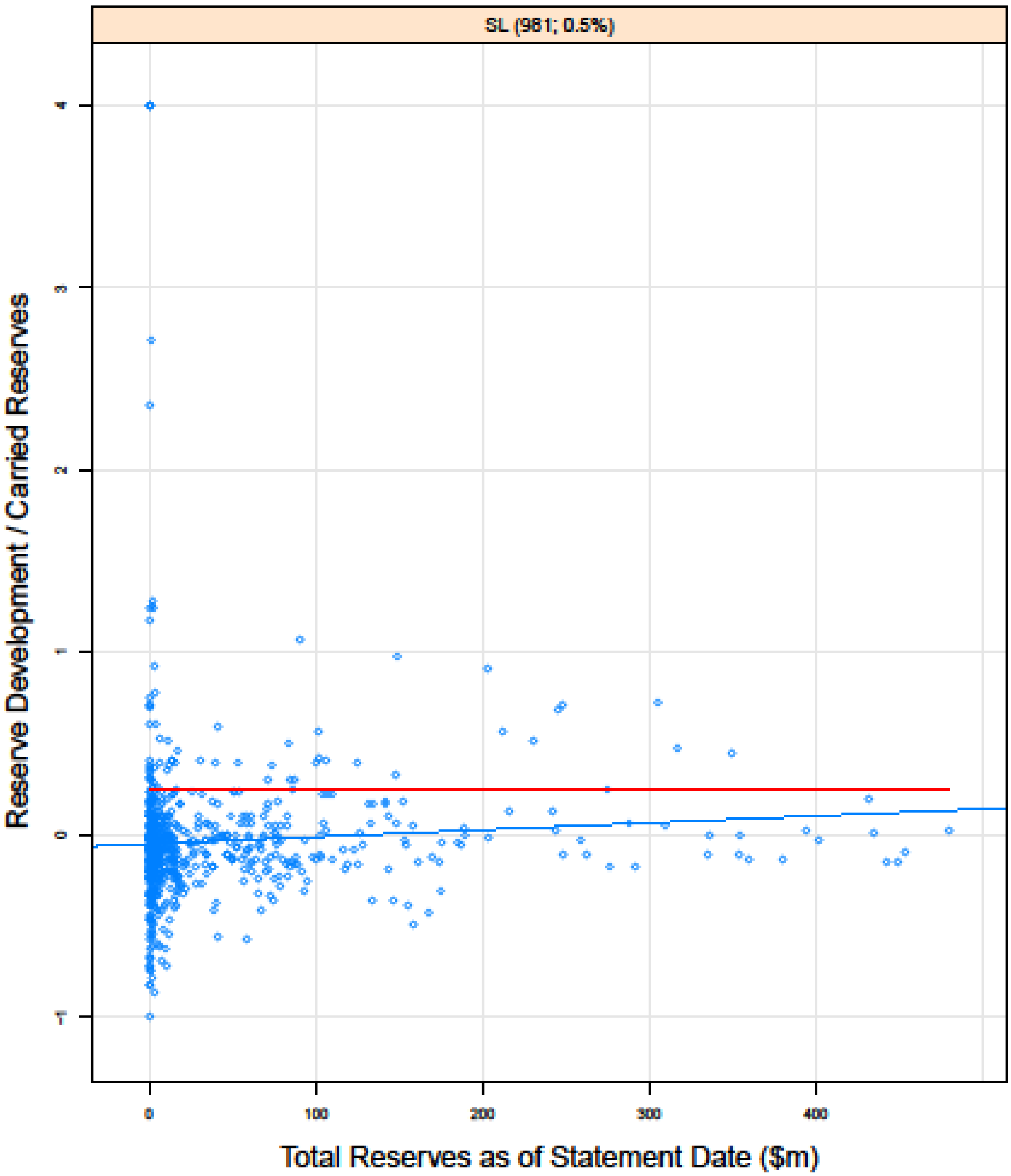
Exhibit B.2
Page 7 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

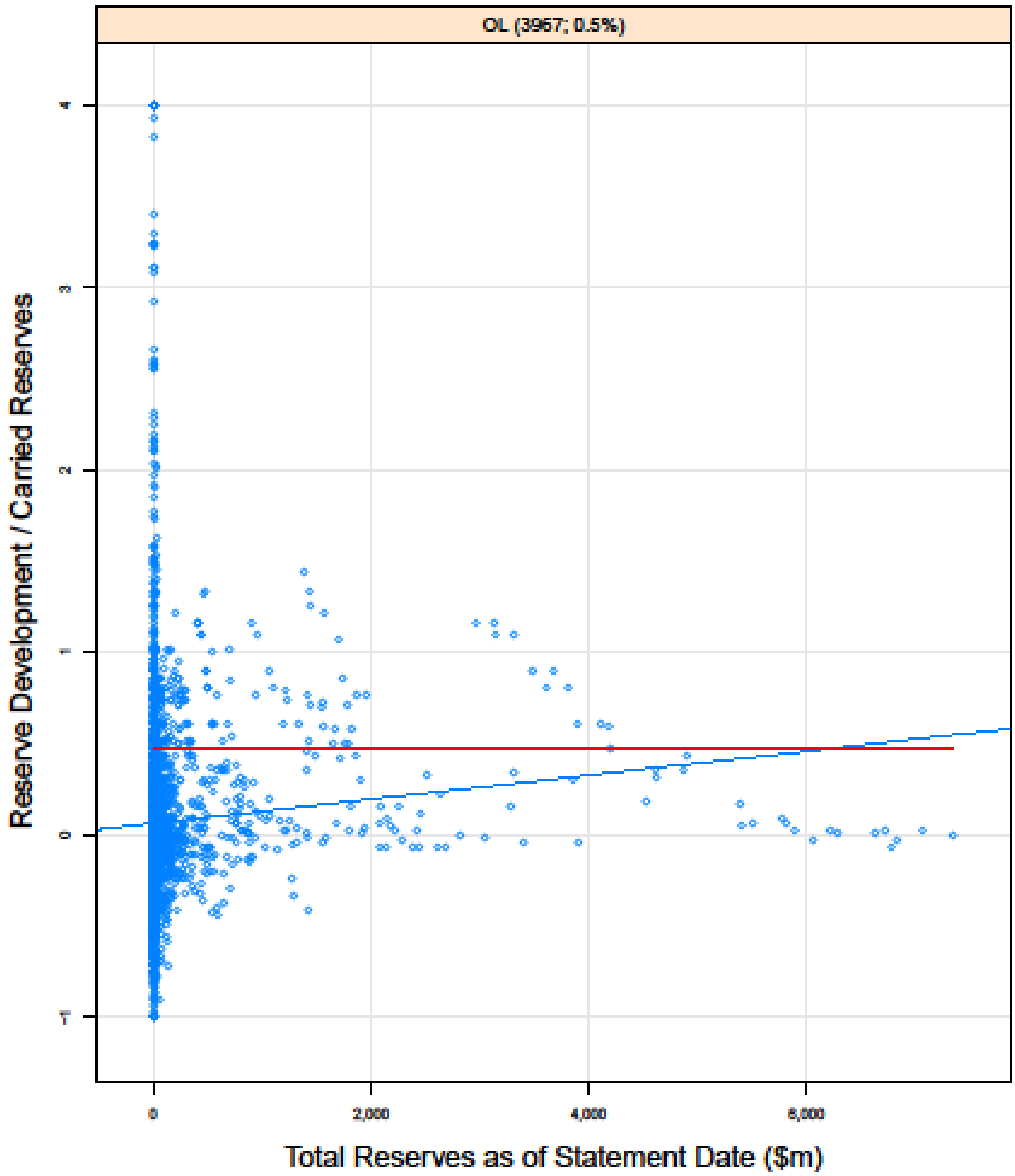
Exhibit B.2
Page 8 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

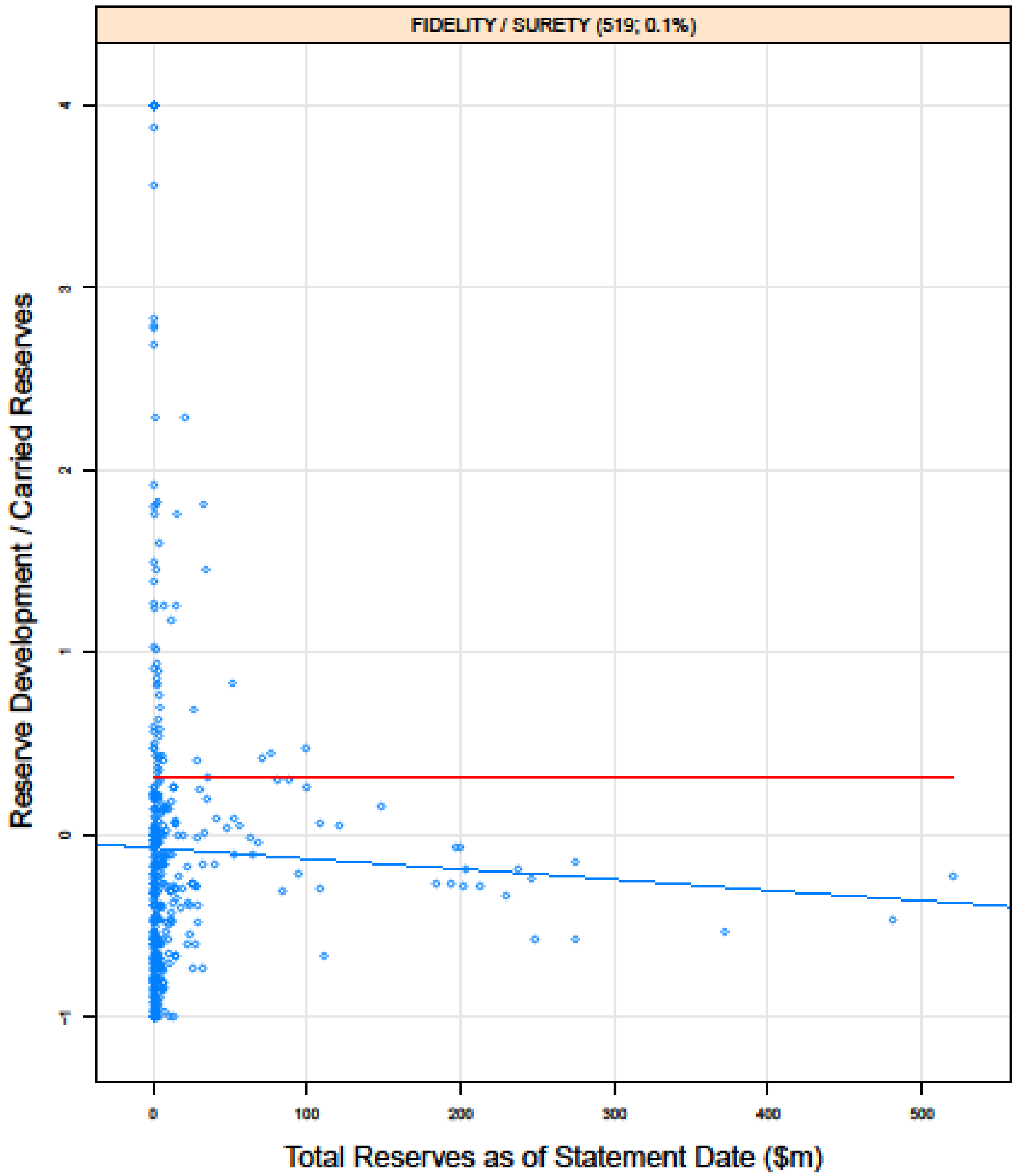
Exhibit B.2
Page 9 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

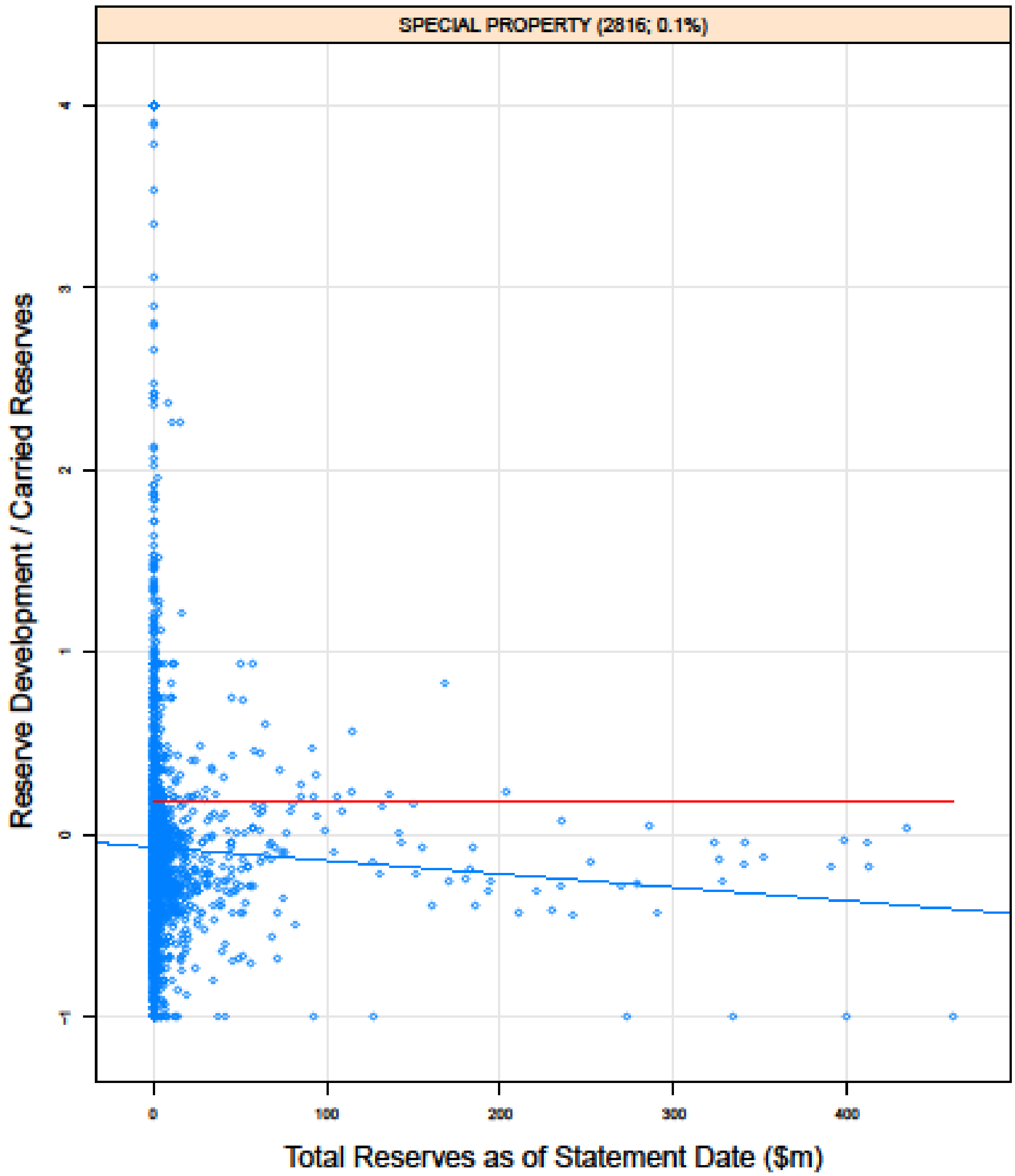
Exhibit B.2
Page 10 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

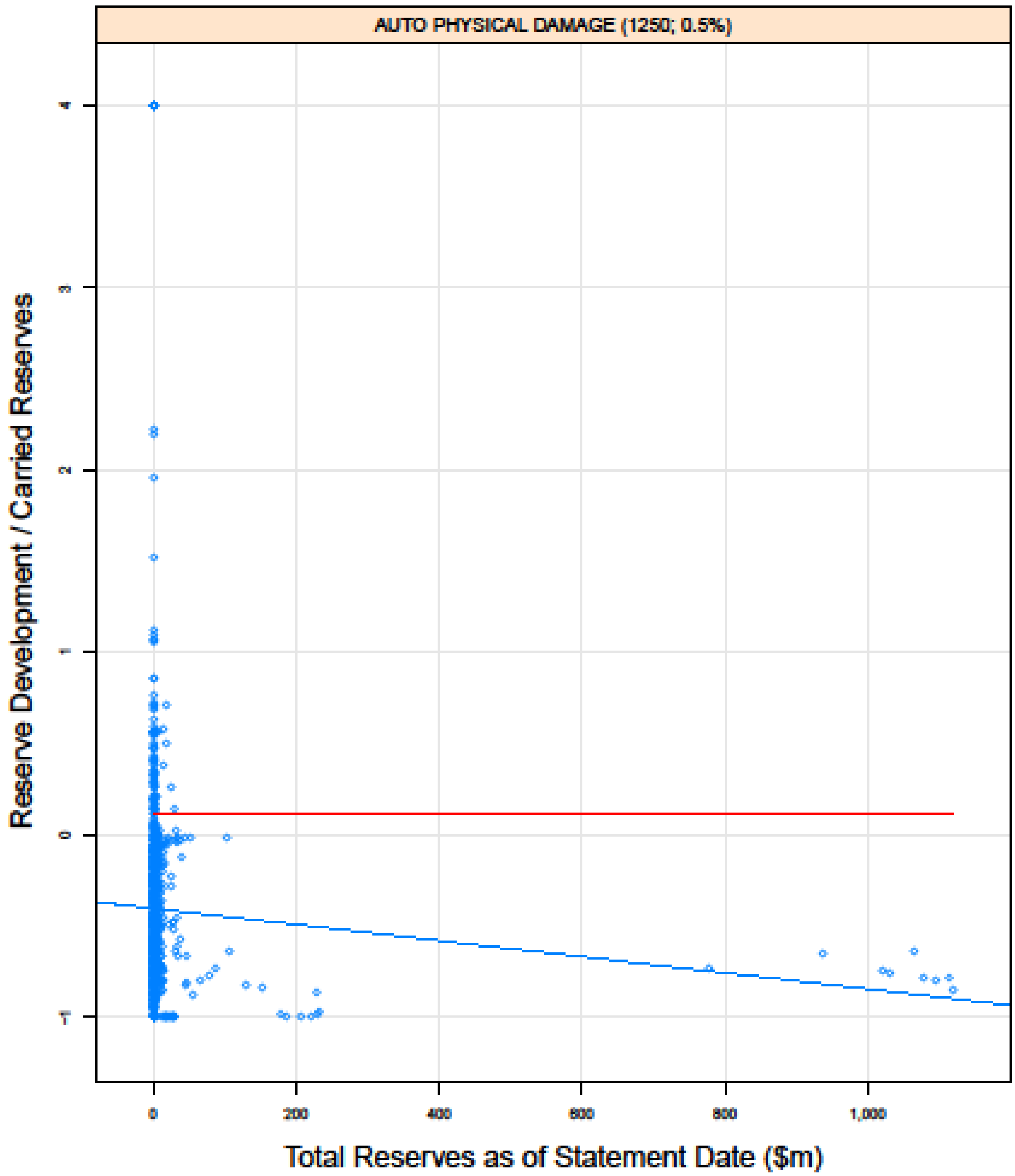
Exhibit B.2
Page 11 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

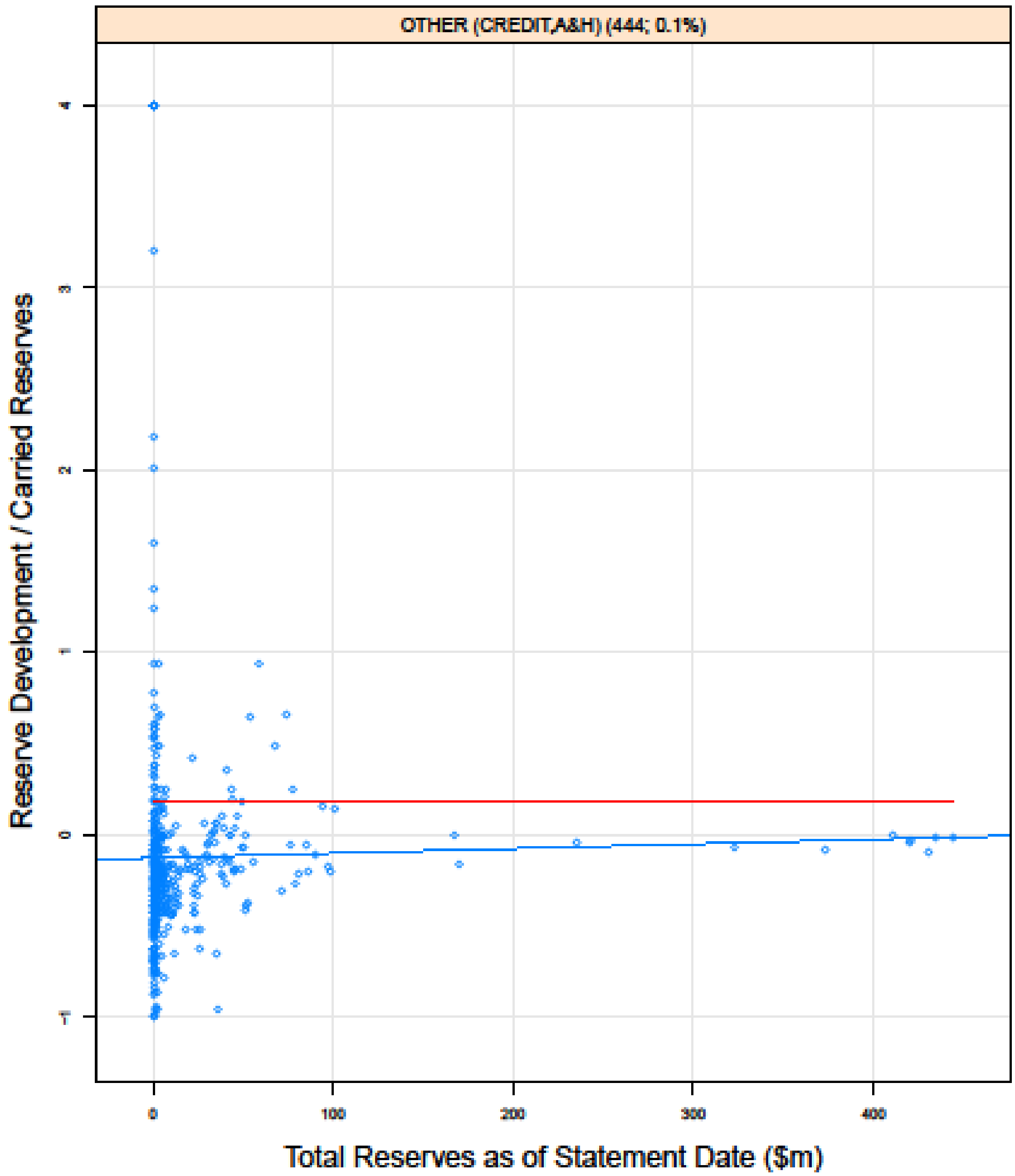
Exhibit B.2
Page 12 of 18



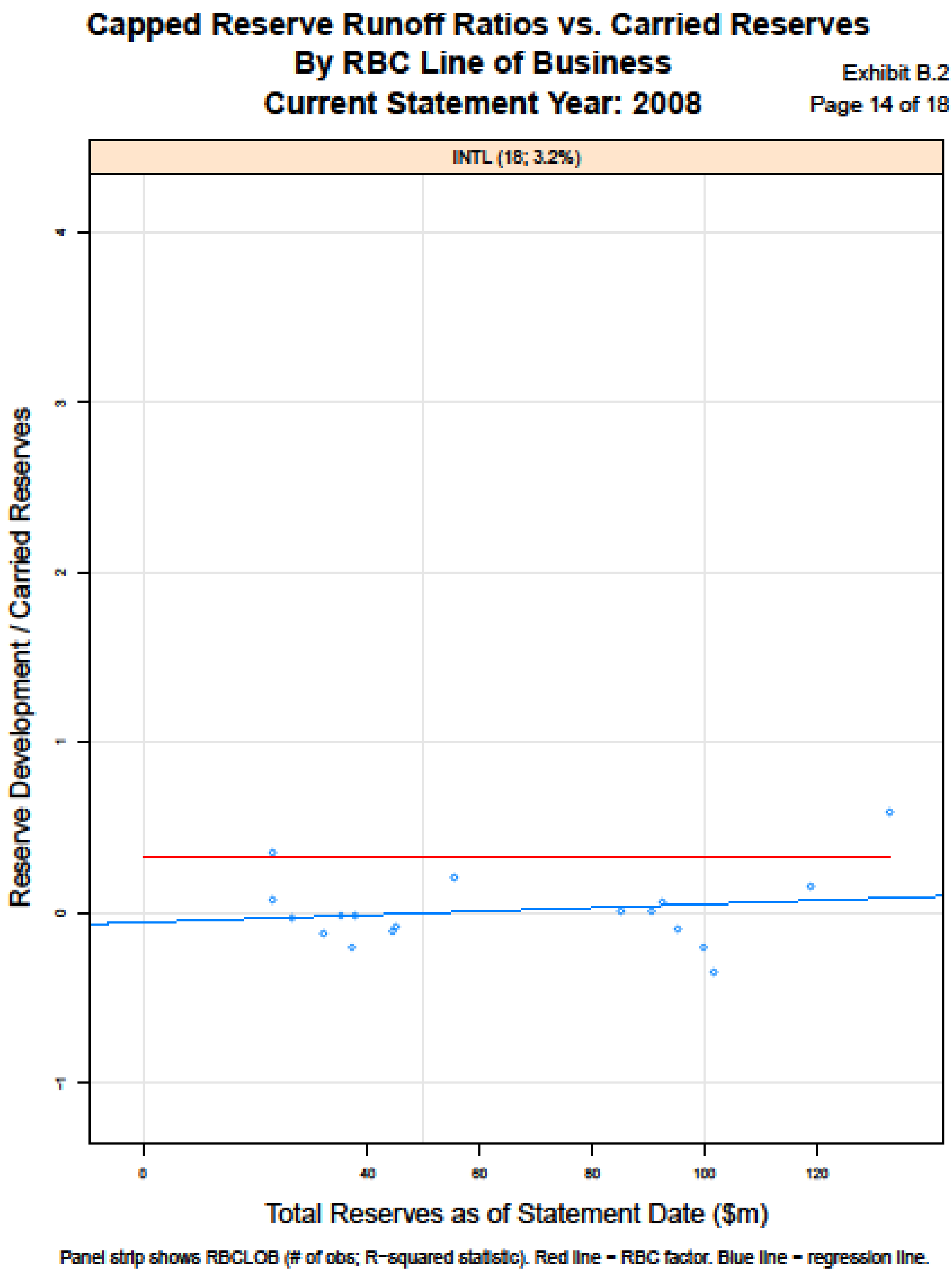
Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

Exhibit B.2
Page 13 of 18

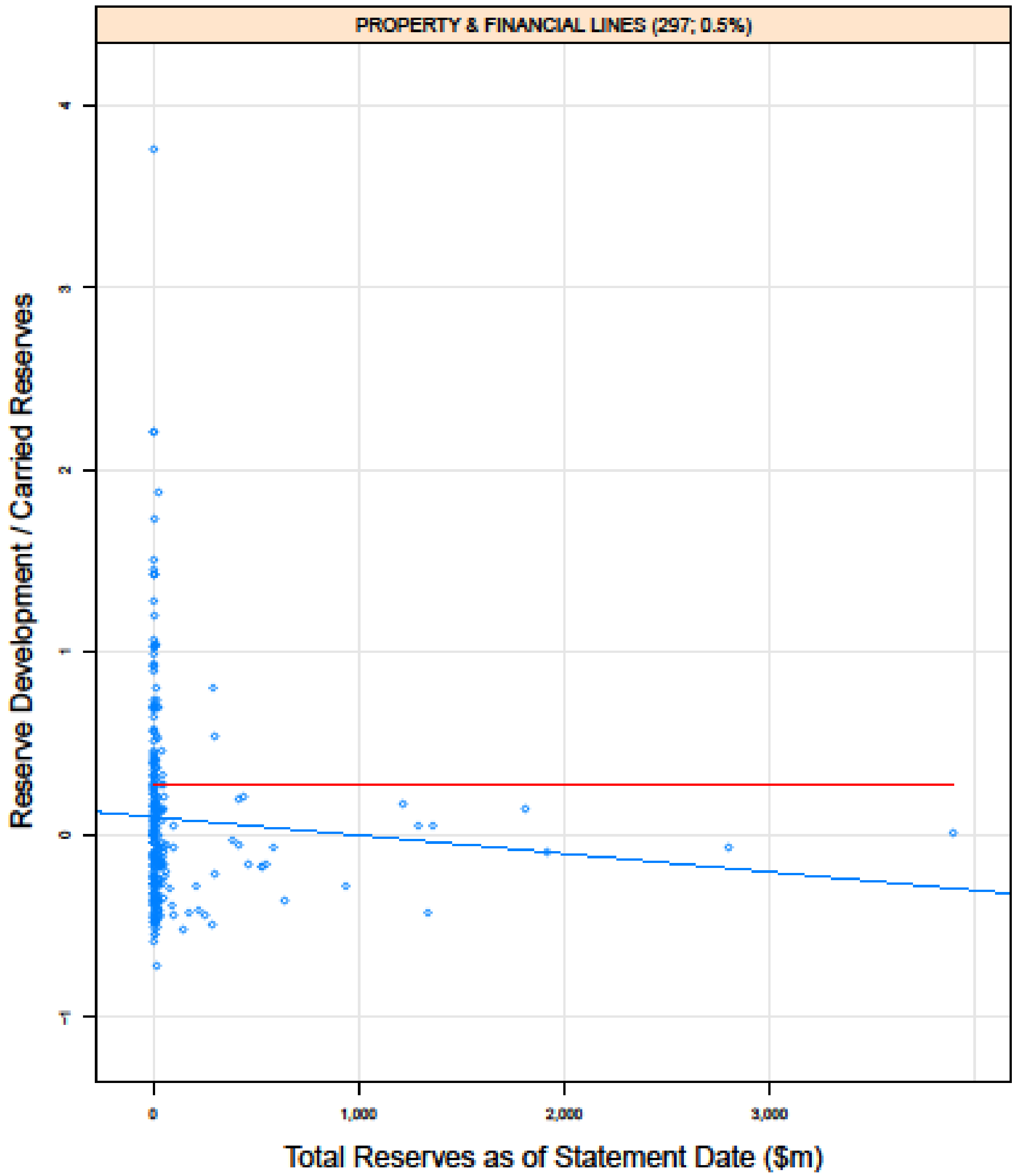


Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.


Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008
Exhibit B.2
Page 14 of 18
INTL (18; 3.2%)
Reserve Development / Carried Reserves
Total Reserves as of Statement Date ($m)
Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

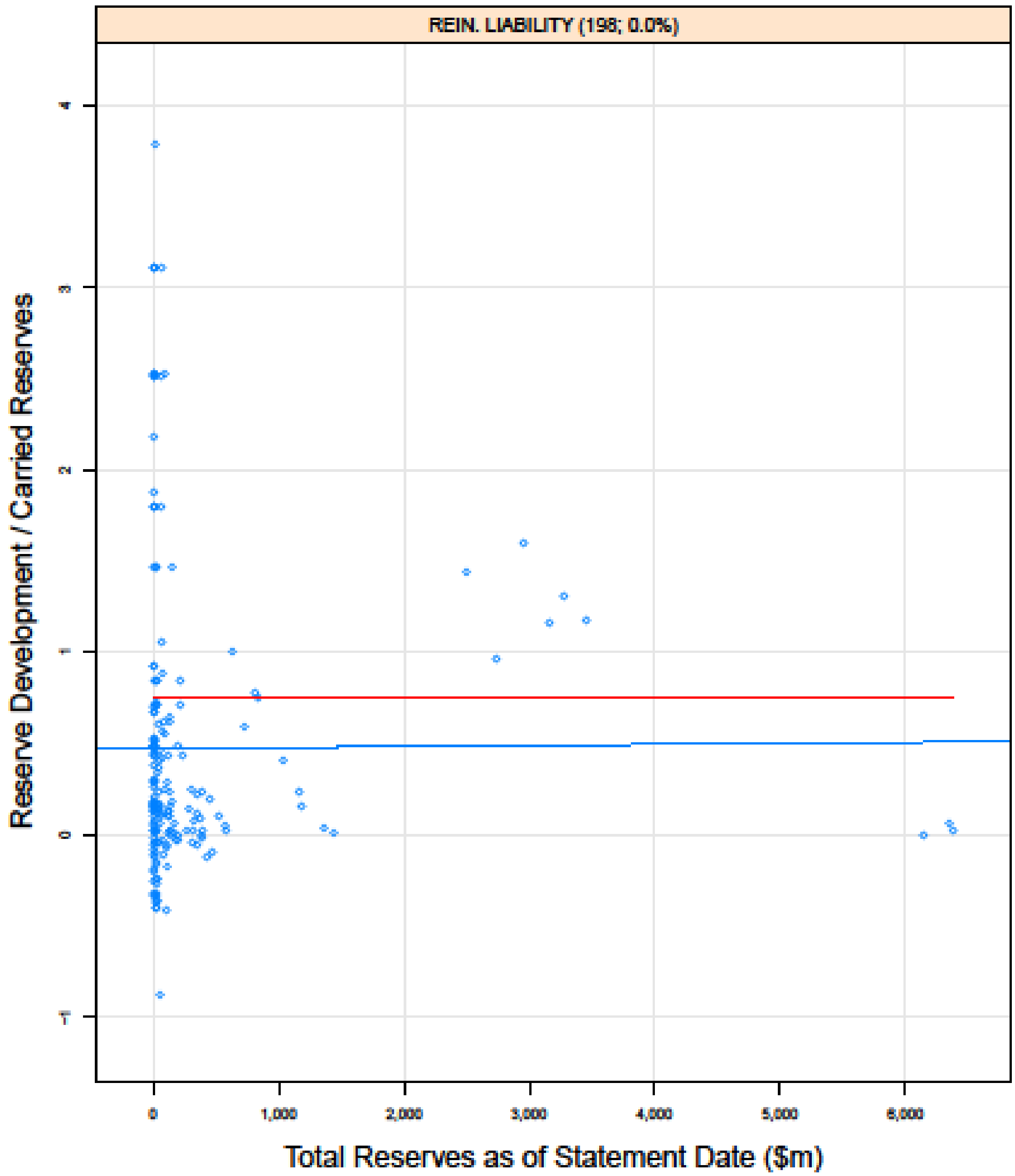
Exhibit B.2
Page 15 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

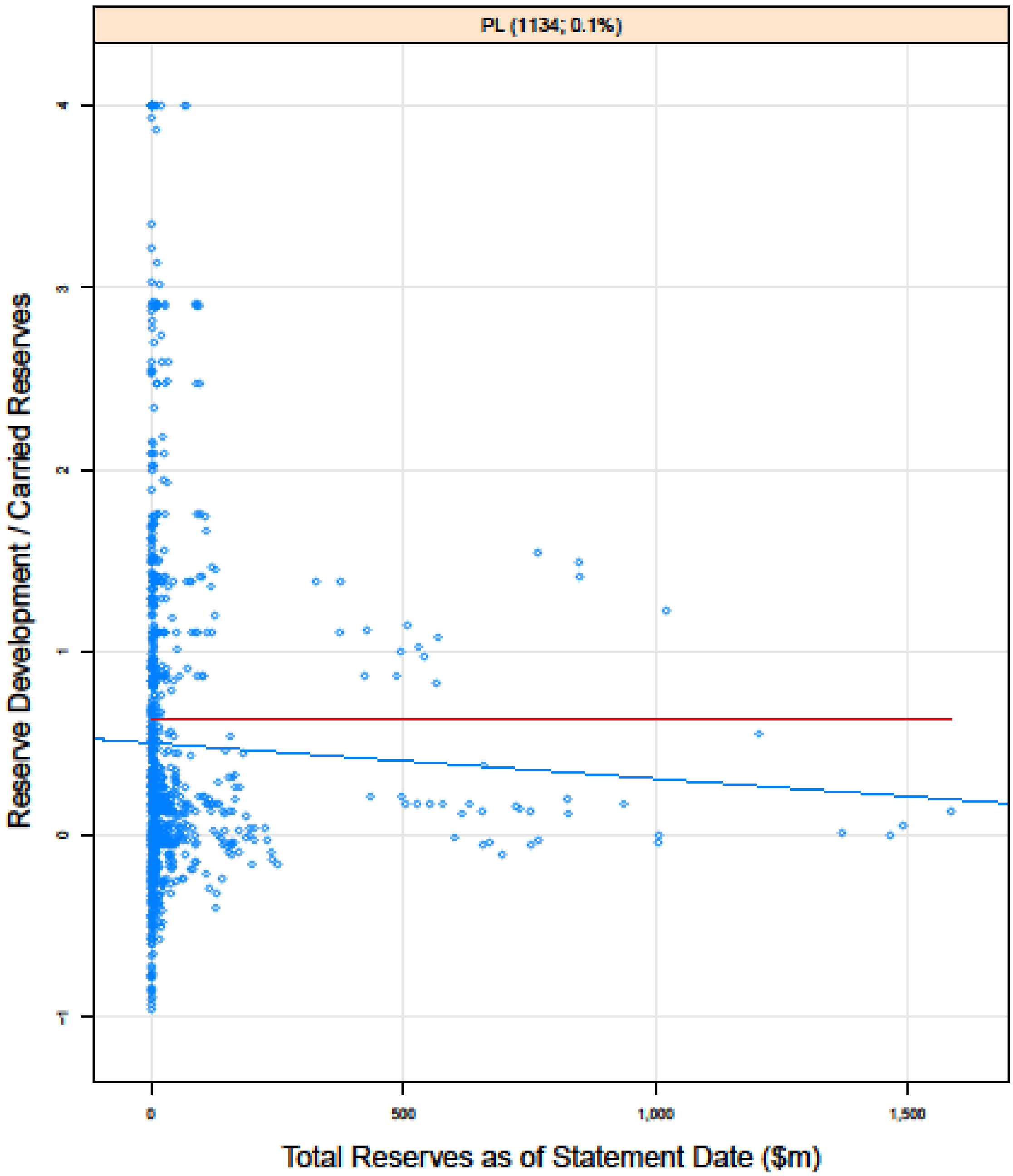
Exhibit B.2
Page 16 of 18



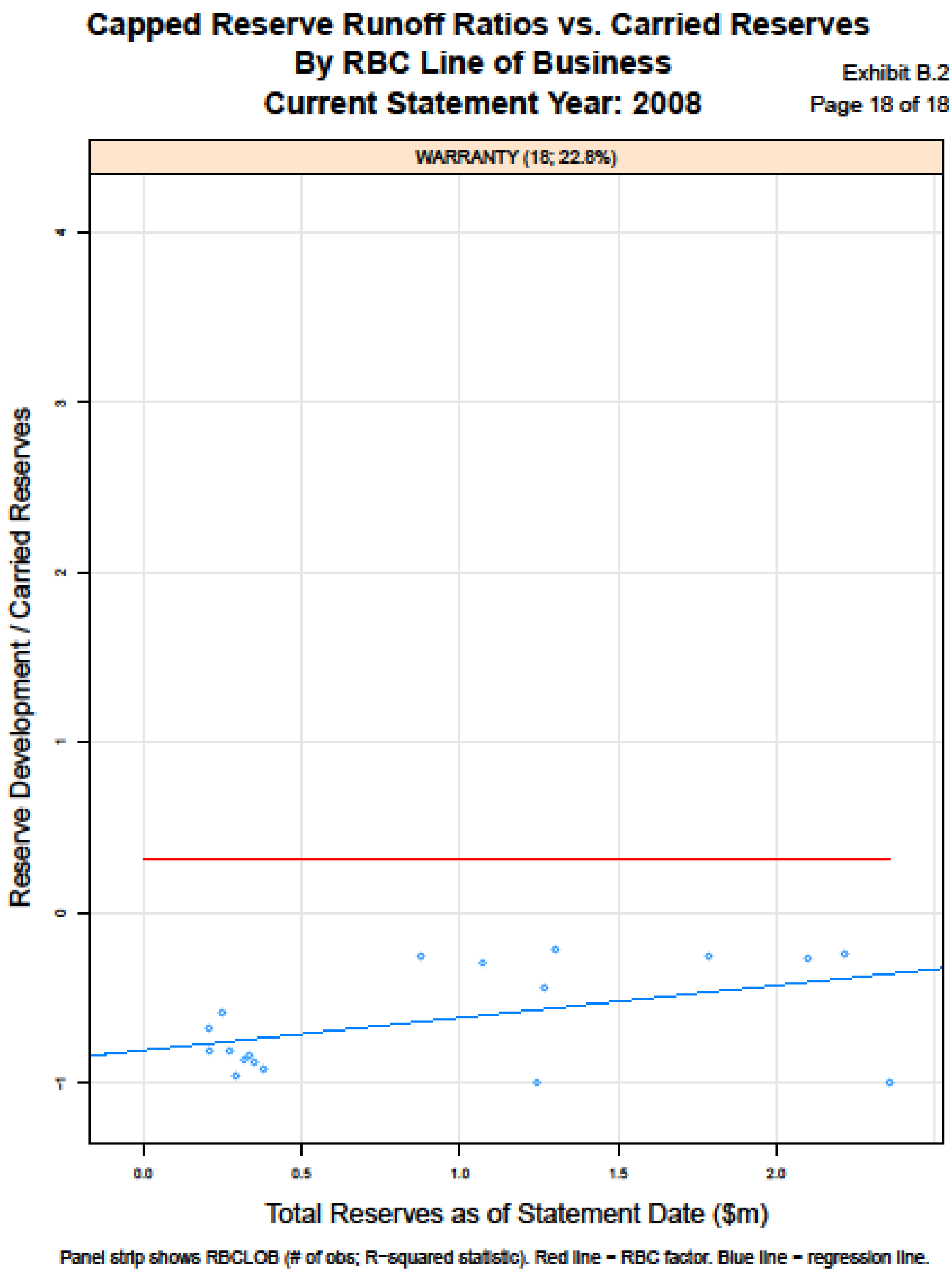
Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008

Exhibit B.2
Page 17 of 18



Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.


Capped Reserve Runoff Ratios vs. Carried Reserves
By RBC Line of Business
Current Statement Year: 2008
Exhibit B.2
Page 18 of 18
WARRANTY (18; 22.8%)
Reserve Development / Carried Reserves
Total Reserves as of Statement Date ($m)
Panel strip shows RBCLOB (# of obs; R−squared statistic). Red line = RBC factor. Blue line = regression line.

Appendix C: Confidence intervals for the RBC reserve charge

In their 2007 report,[15] the American Academy of Actuaries recommended limiting the swing in charges by RBCLOB to 35% of the prior charge. For 2010, the NAIC limited the swing to 5%. Given the limited volume of filtered data and the variability of the reserve run-off ratios, we investigated how likely it is for an RBCLOB charge to exceed the swing limit from one calibration cycle to the next.

In Exhibit C-1 we show estimates of 90% confidence intervals around the 87.5th percentiles by using the 2008 RBC data in the context of a binomial distribution. To find a confidence interval [CR, CL] for the 87.5% quantile[16] (call it "$Q_{.875}$") we start by forming the order statistics $Y_1, \ldots, Y_n$ of the data, which are just the reserve run-off ratios sorted in ascending order. The probability that the k^{th} order statistic Y_k falls below the 87.5 percentile $Q_{.875}$ is the probability that exactly k observations are less than or equal to $Q_{.875}$ and n-k observations are greater than $Q_{.875}$. This probability follows a binomial distribution (where "success" means that a value fall below $Q_{.875}$ and we want the probability of k successes in n trials): $P(Y_k <= Q_{.875})$=pbinom(k, n, .875)=$\binom{n}{k}.875^k(1-.875)^{n-k}$.

A 90% confidence interval for $Q_{.875}$ is found by searching for integers l and r such that

$$P(Y_l \leq Q_{.875} < Y_r) = \sum_{x=l}^{r} \binom{n}{x} .875^x (1-.875)^{n-x}$$

is as close to 90% as possible (in most cases it is not possible to achieve the desired confidence level exactly in problems of this type). Then CL=Y_l and CR= Y_r.

We find that volatility in the Current Calibration Method is highly likely: five of the 19 RBCLOBs (ignoring APD) will reach a 35% swing in 90% of calculations of this type. Virtually all RBCLOBs will exceed a swing of 5% in 90% of calculations of this type.

Exhibit C-2 illustrates how the error margin swing decreases for those RBCLOBs with greater numbers of observations. Auto Physical Damage's result is an anomaly of the line's reserving practices. International's data point (18 observations, 200%) is not shown. This graph illustrates how swings in RBC factors can possibly be tempered by utilizing more data.

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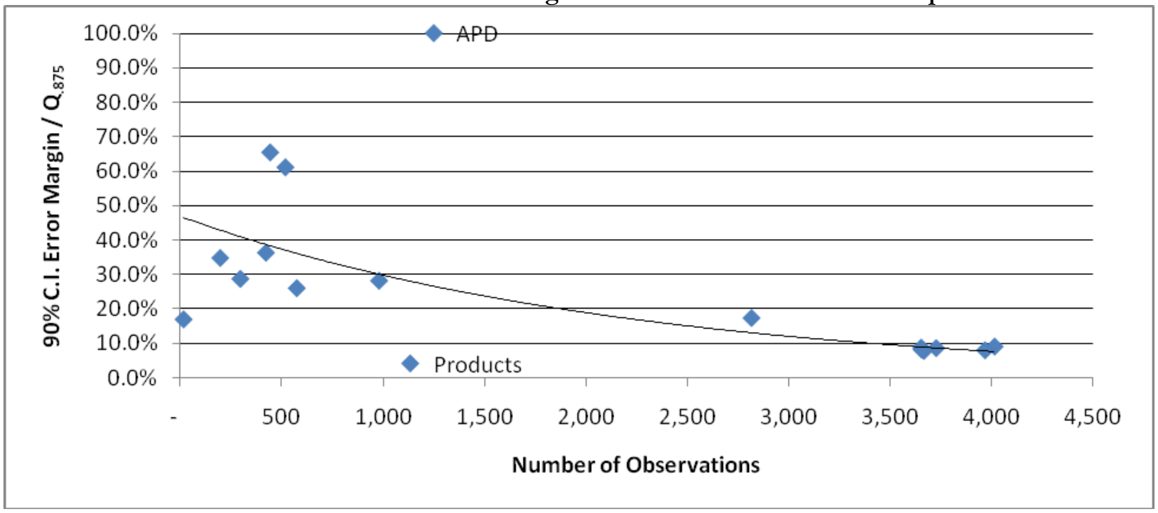
[15] *An Update to P/C Risk-Based Capital Underwriting Factors*, p. 3.

[16] Derivations of distributions of order statistics can be found in statistics texts and online at http://en.wikipedia.org/wiki/Order_statistic#The_joint_distribution_of_the_order_statistics_of_an_absolutely_continuous_distribution. The equi-tailed calculation utilized here follows the R code outlined at http://tolstoy.newcastle.edu.au/R/e2/help/07/02/9857.html. Another helpful online source is http://turing.une.edu.au/~stat354/notes/node72.html. Reserve runoff ratio data probably violate the classic "i.i.d." assumptions underlying the theory; as a result, confidence intervals may be overstated. The data utilized was compiled using unaudited database queries and varies somewhat from that found in the NAIC's spreadsheets. We do not expect the differences to have significant impact on the results.

Exhibit C-1: 87.5 percentiles and Related 90% Confidence Intervals

RBCLOB	Conf Int lower bound	87.5% quantile ($Q_{.875}$)	Conf Int upper bound	C.I. "Error Margin" (E)	E as a percent of $Q_{.875}$	Number of Obs
H/F	0.148	0.161	0.175	0.014	8.50%	3,726
PPA	0.109	0.117	0.128	0.011	9.00%	4,014
CA	0.215	0.222	0.241	0.019	8.60%	3,652
WC	0.323	0.338	0.364	0.026	7.70%	3,666
CMP	0.455	0.476	0.514	0.038	8.10%	3,654
MPL OCCURRENCE	0.164	0.218	0.296	0.079	36.20%	423
MPL CLMS MADE	0.230	0.310	0.330	0.080	25.90%	575
SL	0.118	0.164	0.186	0.046	28.10%	981
OL	0.512	0.534	0.576	0.042	7.90%	3,967
FIDELITY / SURETY	0.306	0.432	0.696	0.264	61.00%	519
SPECIAL PROPERTY	0.326	0.354	0.415	0.061	17.20%	2,816
AUTO PHYSICAL DAMAGE	-0.033	-0.020	-	0.020	100.00%	1,250
OTHER (CREDIT,A&H)	0.082	0.150	0.249	0.098	65.40%	444
FINANCIAL/MORT GUARANTEE	no data					
INTL	0.062	0.200	0.596	0.396	198.30%	18
PROPERTY & FINANCIAL LINES	0.461	0.646	0.739	0.185	28.60%	297
REIN. LIABILITY	0.887	1.357	1.800	0.471	34.70%	198
PL	1.382	1.382	1.438	0.056	4.10%	1,134
WARRANTY	-0.297	-0.254	-0.222	0.043	16.80%	18

Exhibit C-2: 90% Confidence Interval Error Margin Percents as a Function of Sample Size



Appendix D: RBC Action Levels

Authorized Control Level (ACL) RBC = .5 x Total RBC After Covariance[17]

RBC % = ACL RBC / company's Total Adjusted Capital

A company's RBC % determines which of four action levels (if any) take place, summarized in the following table:

Level	Abbrev	RBC %	Regulator Action	Company Action
Company Action Level	CAL	200% of ACL	No action required	Company must submit a plan to improve its capital position
Regulatory Action Level	RAL	150% of ACL	Insurance commissioner is allowed to order corrective actions	Company must submit a plan to improve its capital position; additional actions dependent on commissioner action
Authorized Control Level	ACL	100% of ACL	Insurance commissioner is authorized to take action to protect policyholders and creditors of the company, including rehabilitation or liquidation	Depends on commissioner action
Mandatory Control Level	MCL	70% of ACL	Insurance commissioner must rehabilitate or liquidate the company	

[17] The information in this appendix is based on *Risk-Based Capital Forecasting & Instructions: Property/Casualty*, 2010. 43. See also "Risk Based Capital General Overview,", NAIC, 7/15/2009.

Appendix E: Pro Forma Underwriting RBC Factors

The pro forma underwriting RBC factor is the factor of industry-wide net written premium that indicates the overall combined reserve and premium risk-based capital amount for each line of business. Refer to Exhibit 8 and its footnotes for its method of calculation.

For example, the 2010 Current Homeowners/Farmowners factor of 0.176, also found in Exhibit 8 column (9), is calculated according to following formula:

$$\frac{\sqrt{(0.127 \cdot 22.3)^2 + (0.169 \cdot 59.0)^2}}{59.0}$$

where the current reserve charge (0.127), premium charge (0.169), industry reserves (22.3) and industry net written premium (59.0) come from Exhibit 8. The pro forma factors under alternative approaches are calculated according to the same formula, with the same Exhibit 8 reserve and premium amounts, but using alternative reserve charges from Exhibit 7 and alternative premium charges from Exhibit E.1 below. For example, the 1.396 factor for MM Occurrence in Exhibit E column (10) is

$$\frac{\sqrt{(0.225 \cdot 10{,}884{,}369)^2 + (0.711 \cdot 2{,}036{,}894)^2}}{2{,}036{,}894}$$

where the 0.225 reserve factor under the one-year horizon is from Exhibit 7 column (9), the 0.711 premium factor under the run-off horizon is from Exhibit E.1 column (7), and the reserve and premium dollars are shown here in thousands to reproduce the Exhibit E value to three decimal places.

For the all-lines-combined factor there was no adjustment for diversification by line of business.[18] Neither the line of business nor the overall average factors include provision for growth, loss-sensitive business, or individual company experience. These values do not reflect asset risk or reinsurance or other credit risk, all beyond the scope of the URWP's charge.

Using the alternative factors in Exhibits 7 and E.1, alternative industry-wide premium to reserve risk relativities can be calculated. For example, assuming the 95th percentile is calculated from a Normal distribution fit to the reserve run-off ratios under a one-year horizon (Exhibit 7 column (9)) and from a Normal distribution fit to loss ratios under a run-off horizon (Exhibit E.1 column (7)), the industry-wide premium charge to reserve charge would be as follows, using the factors from the exhibits' "Average" rows and using industry-wide premium and reserve dollars from Exhibit 8:

$$1.204 = \frac{0.253 \cdot 429.5}{0.161 \cdot 560.8}.$$

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[18] If the industry were a single company, the credit for diversification would be approximately 23%.

This is significantly different from the current relativity calculated from Exhibit 8:

$$0.588 = \frac{66.4}{112.9}.$$

Exhibit E: Pro Forma Underwriting RBC Factors

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Filter		2010 Cur	2010 Indi-cated	Alt	Alt	Alt	Alt	Alt	Alt	Alt
Safety Level				87.5	87.5	87.5	87.5	95	95	95
Empirical/Curve Fit				Emp	Norm	Log Norm	Emp	Emp	Norm	Log Norm
Risk Horizon				Runoff	Runoff	Runoff	Rsrv: One Yr, Prem: Runoff	Rsrv: One Yr, Prem: Runoff	Rsrv: One Yr, Prem: Runoff	Rsrv: One Yr, Prem: Runoff
(1) H/F	A	0.176	0.159	0.152	0.238	0.234	0.150	0.296	0.356	0.407
(2) PPA	B	0.197	0.146	0.126	0.181	0.183	0.126	0.184	0.194	0.208
(3) CA	C	0.237	0.205	0.207	0.393	0.390	0.130	0.315	0.320	0.365
(4) WC	D	0.357	0.387	0.325	0.356	0.358	0.199	0.288	0.276	0.303
(5) CMP	E	0.376	0.370	0.280	0.425	0.416	0.084	0.232	0.267	0.315
(6) MM Occurrence	F1	1.438	0.638	1.259	1.634	1.560	0.604	1.409	1.396	1.610
(7) MM CM	F2	0.424	0.555	0.460	0.695	0.660	0.374	0.689	0.683	0.788
(8) SL	G	0.169	0.097	0.139	0.288	0.276	0.090	0.292	0.386	0.458
(9) OL	H	0.908	0.953	1.504	1.614	1.552	0.183	0.390	0.570	0.668
(11) Spec Prop	I	0.184	0.124	0.137	0.227	0.208	0.099	0.333	0.351	0.424
(12) Auto Phys Dam	J	0.094	0.066	0.052	0.070	0.068	0.050	0.100	0.125	0.142
(10) Fidelity & Surety	K	0.209	0.242	0.654	0.914	0.759	0.289	0.730	0.890	1.026
(13) Other	L	0.121	0.119	0.153	0.317	0.281	0.153	0.328	0.494	0.583
(15) International	M	0.424	0.424	0.370	0.658	0.600	0.344	1.034	0.882	1.022
(16) Reins Property & Financial	N&P	0.515	0.963	0.564	0.705	0.620	0.545	1.125	0.896	1.026
(17) Reins Liability	O	2.725	5.473	3.117	3.349	3.240	0.508	1.301	1.638	1.887
(18) Products Liability	R	2.298	6.176	5.385	5.832	5.404	0.624	2.579	2.406	2.773
(14) Fin & Mort*	S	0.585	0.585	0.585	0.585	0.585	0.585	0.585	0.585	0.585
(19) Warranty	T	0.077	0.162	0.098	0.202	0.113	0.062	0.494	0.377	0.445
Average		0.305	0.359	0.352	0.443	0.425	0.138	0.297	0.328	0.377

See notes to Exhibit 2.

Exhibit E.1: Alternative Premium Charges

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Filter		2010 Current	Indicated	Alt	Alt	Alt	Alt
Safety Level				87.5	95	95	95
Empirical/Curve Fit				Empirical	Empirical	Normal	Log Normal
Time Horizon				Runoff	Runoff	Runoff	Runoff
(1) H/F	A	0.169	0.152	0.149	0.290	0.348	0.398
(2) PPA	B	0.171	0.138	0.118	0.178	0.176	0.187
(3) CA	C	0.154	0.099	0.106	0.264	0.250	0.289
(4) WC	D	0.142	0.125	0.111	0.236	0.221	0.254
(5) CMP	E	0.100	0.069	0.055	0.197	0.195	0.236
(6) MM Occurrence	F1	0.672	0.572	0.541	0.819	0.711	0.811
(7) MM CM	F2	0.178	0.392	0.352	0.589	0.558	0.640
(8) SL	G	0.087	0.075	0.066	0.210	0.210	0.262
(9) OL	H	0.125	0.093	0.094	0.305	0.283	0.346
(11) Spec Prop	I	0.168	0.050	0.067	0.285	0.272	0.330
(12) Auto Phys Dam	J	0.094	0.065	0.050	0.097	0.120	0.135
(10) Fidelity & Surety	K	0.073	0.160	0.050	0.489	0.363	0.429
(13) Other	L	0.121	0.119	0.153	0.328	0.494	0.583
(15) International	M	0.333	0.333	0.270	0.909	0.628	0.728
(16) Reins Property & Financial	N&P	0.480	0.823	0.536	1.068	0.828	0.946
(17) Reins Liability	O	0.446	0.601	0.424	0.827	0.660	0.758
(18) Products Liability	R	0.215	0.272	0.110	0.458	0.403	0.488
(14) Fin & Mort*	S	0.585	0.585	0.585	0.585	0.585	0.585
(19) Warranty	T	0.073	0.160	0.050	0.489	0.363	0.429
Average		0.155	0.135	0.116	0.256	0.253	0.291

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Abbreviations and notations
ACL, authorized control level
APD, automobile physical damage
AY, accident year
DCC, direct and cost-containment
IFRS, international financial reporting standards
IIO, investment income offset
NAIC, National Association of Insurance Commissioners
RBC, risk-based capital
RBCLOB, risk-based capital line of business
RRR, reserve run-off ratio
URWP, Underwriting Risk Working Party