

Property and Casualty Risk-Based Capital Premium and Loss Concentration Factors

American Academy of Actuaries Risk Based Capital Committee

Introduction

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- This Report is presented by the American Academy of Actuaries (Academy) Risk Based Capital (RBC) Committee (The Committee)
- This Report is presented to the National Association of Insurance Commissioners (NAIC) Property/Casualty Risk Based Capital Working Group
- The Report addresses the Premium and Loss Concentration Factors (PCF/LCF) in the RBC Formula.

This presentation is a high-level summary. Refer to the final report for explanations of the methodology and implications of the analysis that produced the results presented here.

The analysis and conclusions in this Report reflect the opinions of the committee members and do not necessarily reflect the views of their employers or the actuarial organizations in which they are members.

Key Terms:

Concentration and Diversification Credit in RBC Formula

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- **Concentration Ratio:**
The Premium/Reserve amount in the “largest” Line of Business (LOB) divided by the total Premium/Reserve amount. We call this the **CoMaxLine%**.
- **Degree of diversification = 100% – concentration ratio%**
Company with 2 LOB (75% and 25% LOB Premium)
Concentration = 75% (largest LOB)
Diversification = 25% (100% – 75%)
- PCF/LCF depends on a parameter we call the **Maximum Diversification Credit (MDC), currently 30%**
$$\text{PCF/LCF} = (1.0 - \text{MDC}) + \text{MDC} * \text{CoMaxLine\%}$$
$$\text{Diversification Credit} = 1.0 - \text{PCF/LCF}$$

Scope of Analysis

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The scope of our work is:

- Evaluate the MDC:
 - It determines the total diversification credit, and
 - It is a key parameter in the diversification by company.
- Assess whether the linear relationship of diversification credit to CoMaxLine% is reasonable.
- Evaluate other issues arising.

IMPACT

Findings

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Finding 1:

The committee believes that MDCs of **45% for premium and 65%** for reserves are reasonable selections that are better supported by the data than the **current 30% MDC**. We refer to these as the indicated MDCs.

There are reasonable alternative MDC selections, which we discuss later in this presentation.

Impact of revised MDC—45% and 65%

Part 1

Indicated Change in RBC Value by Type of Company					
(1)	(2)	(3)	(4)	(5)	(6)
Row	Type of Company	ACL - \$ Billions (2022)	% Change		
			Premium Risk Charge	Reserve Risk Charge	ACL
1	Commercial	84.4	-11.7%	-21.6%	-13.4%
2	Med Prof Liab	2.9	-3.4%	-8.0%	-1.9%
3	NOC	0.7	-3.1%	-6.5%	-2.2%
4	Personal	100.2	-9.2%	-18.2%	-2.1%
5	Reinsurance	9.5	-11.4%	-22.3%	-2.4%
6	Workers Comp	7.5	-4.5%	-10.0%	-5.7%
7	Total	205.3	-10.0%	-20.0%	-6.9%

Part 2

Number and % Cos by Size of Change		
(7)	(8)	(9)
% Change in ACL	# Cos.	% Cos
Less than -50%	0	0%
-35% to -50%	0	0%
-25% to -35%	46	3%
-15% to -25%	202	11%
-5% to -15%	500	28%
0% to -5%	676	37%
0%	393	22%
Greater than 0%	0	0%
Total	1,817	100%

Part 3

Div Band	% Chng
(10)	(11)
0	0.0%
1	-0.7%
2	-3.2%
3	-7.1%
4	-10.5%
5	-16.6%
All	-6.4%

59%

Impact is higher for more diversified companies.

DATA

Companies by Size and Diversification Level—Premium-1

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Number of Companies by Co Size/Diversification (\$billions)						
Div/Size	A	B	C	D	E	All
0	5,067	3,303	2,003	1,393	1,065	12,831
1	1,509	1,728	2,017	1,637	1,013	7,904
2	1,478	1,717	1,804	1,812	1,091	7,902
3	1,318	1,605	1,752	1,801	1,426	7,902
4	878	1,496	1,703	1,789	2,036	7,902
5	219	619	1,189	2,037	3,838	7,902
All	10,469	10,468	10,468	10,469	10,469	52,348

Premium by Co Size/Diversification (\$billions)						
Div/Size	A	B	C	D	E	All
0	3	13	26	69	438	549
1	1	7	27	78	356	469
2	1	7	25	90	714	837
3	1	6	25	89	1,821	1,942
4	1	6	23	88	2,173	2,291
5	0	3	17	109	5,156	5,284
All	7	42	142	523	10,659	11,373

Premium concentrated in larger companies:

C3-E5:
34% of companies;
84% of premium

E5 alone:
7% of companies;
39% of premium

Size E
20% of companies
94% of premium

Companies by Size and Diversification Level—Premium-2 10

Modeled diversification by Size/Diversification Band (\$millions)						
Div Band	Size					Total
	A	B	C	D	E	
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.1	0.5	1.6	2.2
2	0.0	0.1	0.4	1.6	11.2	13.4
3	0.0	0.2	0.6	2.4	41.4	44.6
4	0.0	0.2	0.8	3.1	74.3	78.5
5	0.0	0.1	0.7	4.9	252.7	258.4
Total	0.1	0.7	2.7	12.4	381.3	397.1

Based on Modeled Risk before and after diversification, before IIA

Diversification credit is concentrated in large diversified companies.

C3-E5:
 34% of companies
 84% of premium
 96% of diversification credit

E5 alone:
 7% of companies
 39% of premium
 64% of diversification credit

Size E:
 20% of companies
 94% of premium
 96% of diversification credit

BASE ANALYSIS

Indicated MDC—Sample Size “D”/Diversification 5

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	(1)	(2)	(3)
#	Item	Premium	Reserves
1	Observed Risk - 87.5th Percentile	15.8%	25.9%
2	Modeled Risk - 87.5th Percentile before diversification credit	21.0%	38.0%
3	Indicated Diversification Credit $[1.0 - (1)/(2)]\%$	25.0%	32.0%
4	Average Diversification Credit (Current Formula)	21.0%	19.2%
5	Indicated Maximum Credit $[(3)/(4)] * 30\%$	36%	50%

The indicated diversification is the ‘difference’ between the observed risk and the modeled risk before diversification credit.

The indicated diversification credit is larger than the diversification credit produced by CoMaxLine% approach with a 30% MDC.

An MDC of 36% for premium and 50% for reserves would ‘equalize’ the modeled risk and observed risk for this Size/ Diversification cell, implying:

$$PCF = 0.64 + 0.36 * CoMaxLine\%$$

$$LCF = 0.50 + 0.50 * CoMaxLine\%$$

Indicated MDC—Weighted Average of C3-E5

Premium

Reserves

Divers Band Quintiles	Indicated Max Diversification Credit (Part 5)					Divers Band Quintiles	Indicated Max Diversification Credit (Part 5)				
	Size Band Quintiles						Size Band Quintiles				
	A	B	C	D	E		A	B	C	D	E
0						0					
1	-2614%	26%	-17%	328%	348%	1	-1739%	-2109%	394%	628%	1190%
2	-500%	-63%	2%	86%	87%	2	-491%	-229%	43%	215%	367%
3	-405%	3%	28%	33%	68%	3	-232%	-73%	26%	96%	160%
4	-206%	28%	42%	44%	67%	4	-91%	-36%	22%	64%	83%
5	-413%	-23%	38%	36%	52%	5	-165%	-2%	36%	50%	61%
All	-890%	0%	51%	80%	76%	All	-554%	-145%	73%	107%	121%
	C3-E5 Unweighted		45.1%	Weighted	45.9%		C3-E5 Unweighted		66.5%	Weighted	66.3%
	StdDev		13.5%	StdDev	12.9%		StdDev		40.5%	StdDev	37.5%
(Part 5) = 0.30 * (Part 3)/(Part 4)						(Part 5) = 0.30 * (Part 3)/(Part 4)					

Premium Indicated MDC—By Size and Diversification

Div Band	Size Band		
	A	B	C
1	-2614%	26%	-17%
2	-500%	-63%	2%
3	-405%	3%	
4	-206%	28%	
5	-413%	-23%	
All	-890%	0%	

Alternative Average	Indicated MDC
Using 6-cell average D3.E5 (Largest)	50%
Using 6-cell average C4.E5 (Most diversified)	48%
Using 4-cell average D4.E5	50%

Div Band	Size Band	
	D	E
1	328%	348%
2	86%	87%

Div Band	Size Band		
	C	D	E
3	28%	33%	68%
4	42%	44%	67%
5	38%	36%	52%
	C3-E5	Wtd	45.9%
		StdDev	12.9%

1. Small companies indicate higher Line 4 factors.

That 'disconnect' appears as negative MDCs, i.e., a diversification surcharge.

2. Specialized companies, low diversification companies, indicate lower Line 4 factors.

That disconnect appears as a very high indicated MDC.

3. We focus on larger/more diversified companies.

There is a smaller, but still not small, variation in the indicated MDC in this group.

Reserve Indicated MDC—By Size and Diversification

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Div Band	Size Band		
	A	B	C
1	-1739%	-2109%	394%
2	-491%	-229%	43%
3	-232%	-73%	
4	-91%	-36%	
5	-165%	-2%	
All	-554%	-145%	

Alternative Average	Indicated MDC
Using 6-cell average D3.E5 (Largest)	80%
Using 6-cell average C4.E5 (Most diversified)	55%
Using 4-cell average D4.E5	64%

Div Band	Size Band	
	D	E
1	628%	1190%
2	215%	367%

Div Band	Size Band		
	C	D	E
3	26%	96%	160%
4	22%	64%	83%
5	36%	50%	61%
	C3-E5	Wtd	66.3%
		StdDev	37.5%

The variation in indicated MDC is qualitatively the same for reserve risk as for premium risk.

The variation in indicated MDC in the C3-E5 cells is wider for reserve risk than for premium risk.

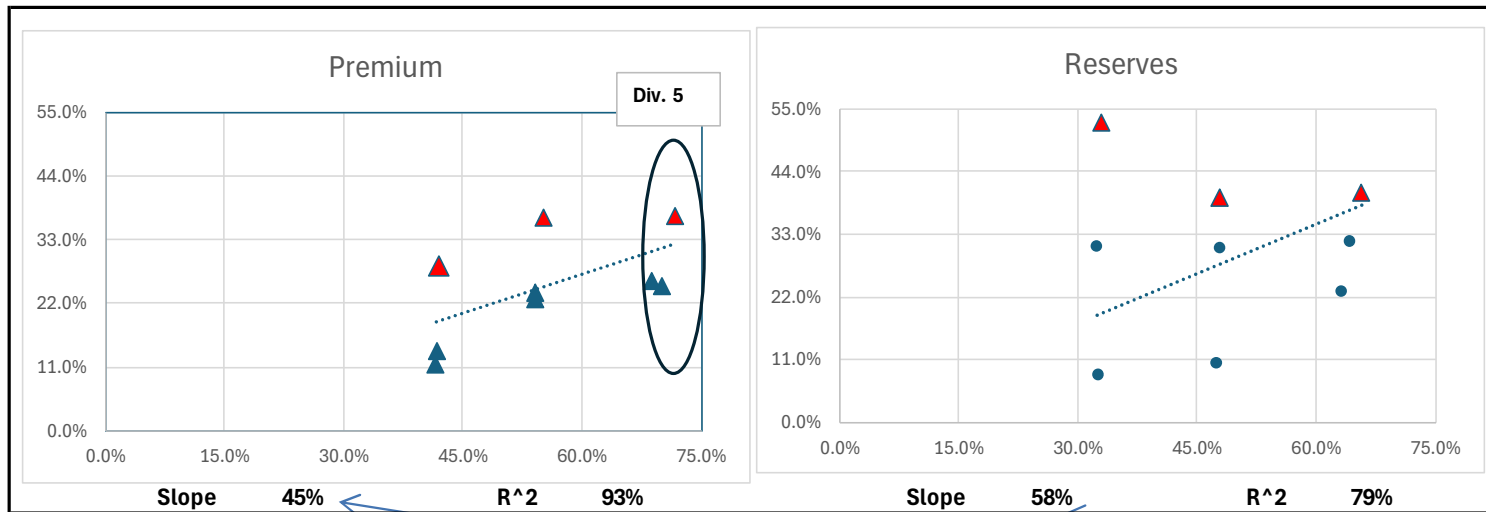
For example, the 9-cell average is similar to the 6-cell and 4-cell averages for premium risk, but the alternatives vary much more widely for reserve risk.

This makes the selection of MDC less clear-cut than desirable.

TEST LINEAR RELATIONSHIP REGRESSION

Regression Analysis of CoMaxLine% Approach Is indicated Credit Linear with respect to CoMaxLine%?

Y-Axis = Indicated Risk Charge



X-Axis = Diversification Index (1-CoMaxLine%)

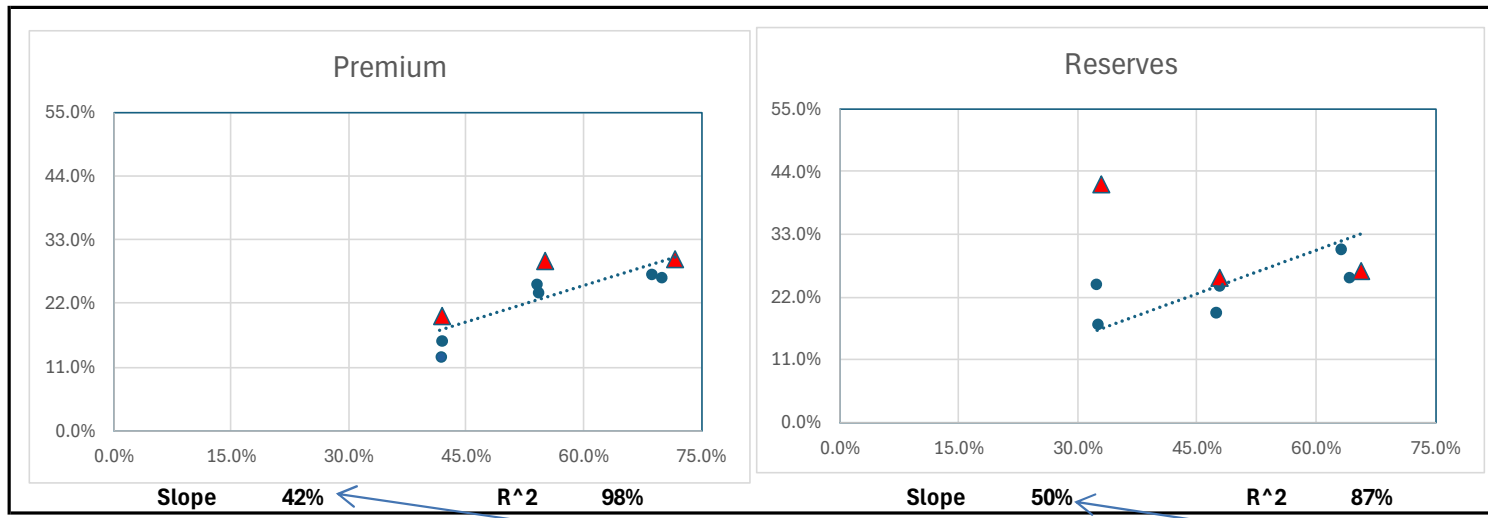
Slope = Indicated maximum diversification credit

Regression of diversification Index vs. indicated risk charge.

Size E shown with red triangles.
Note that these are generally outliers.

Regression Analysis of CoMaxLine% Approach- After Size Adjustment

Y-Axis = Indicated Risk Charge



X-Axis = Diversification Index (1-CoMaxLine%)

Slope = Indicated maximum diversification credit

Regression of diversification Index vs. indicated risk charge.

Size E shown with Red triangles.
Variability is reduced for all size bands after size adjustment.
Apart from reserves Div 3, Size E is more in line with other sizes.

Finding 2

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Finding 2:

While the linear relationship between diversification credit and CoMaxLine% is not exact, considering the alternatives, the Committee believes it is a reasonable approximation, especially for more diversified companies.

ALTERNATIVE INDICATED MDCs

Time Periods and Use of RBC Data—Additional Alternatives²¹

(1)	(2)	(3)
Label	Indicated MDC	
	Premium	Reserves
Base indicated MDC	46%	66%
Early 15 Years vs. Recent 15		
Yrs - 1988-2002	42%	58%
Yrs - 2003-2017	63%	85%
Use RBC Two-Year LOB Data		
AS + RBC	56%	59%

1. Time frame:

Earlier period indicated MDC is lower→greater between line dependency.

Two factors that might contribute are lower catastrophe activity and higher inflation/ interest rates in the earlier period.

2. RBC data:

Line 4 calibration used RBC data to calibrate “risk factors for Two-Year LOBs and AS data to calibrate risk factors for Ten-Year LOB risk factors.

Calibrating dependency involves combining Two-Year and Ten-Year LOBs, and there are technical issues in melding those data sources.

We lack sufficient transparency in the RBC data to evaluate the reasons for the observed difference in MDC indications, so we rely on AS data.

Alternative Indicated MDCs—Summary

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Item	Alternative Method	Indicated MDC	
		Premium	Reserve
1	Base indicated MDC	46%	66%
2	Use Size Adjusted Line 4 Factors	42%	56%
3	Using combined RBC and Annual Statement data to calibrate indicated MDCs	56%	59%
4	Using 6-cell average D3.E5 (Largest)	50%	80%
5	Using 6-cell average C4.E5 (Most diversified)	48%	55%
6	Using 4-cell average D4.E5	50%	64%
7	Regression analysis	45%	58%
8	Early years only (1988-2002)	42%	58%
9	Recent years only (2003-2017)	64%	85%
	Yellow= MDC lower than row 1		
	Green = MDC higher than row 1		

This summarizes the alternatives we have discussed.

These are reasonable alternatives for the NAIC to consider.

QUALITATIVE CONSIDERATIONS

Theoretical Framework

1. Diversification Metrics / Risk Theory vs Ratemaking and Risk Classification

Technical Issues

2. Order of Operations—IIA and Diversification Credit

As with every analysis

3. Calibration Safety Level

1a. Why Use CoMaxLine% and Not “Something Better”?

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We reviewed and considered the conclusion from the two 2019 Casualty Actuarial Society (CAS) Dependency and Calibration Working Party (DCWP) reports on alternative diversification formulas.

DCWP considered alternatives to CoMaxLine%, including:

- The Correlation Factor approach,
- The CoMaxLine% approach using LOB risk, rather than LOB premium/serves (“volume”), and
- The Herfindahl-Hirschman Index (HHI), rather than CoMaxLine%.

1b. Why Use CoMaxLine% and Not “Something Better”

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DCWP found that alternatives to CoMaxLine%:

- Do not produce very different results, by company,
- Do not indicate greater accuracy, and
- Are not theoretically more appropriate in the context of the RBC Formula.

1c. Why Correlation Approach is Not Theoretically Better than CoMaxLine% in RBC

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Individual Company Capital Modeling (ICCM): Grounded in Risk Theory
Company-specific risk charges relate to risks underwritten by the insurer.
Multiple risks combined with **correlation relationships**.

Unlike the ICCM, the RBC Formula is calibrated from and applies to a heterogeneous population of insurers.

The ICCM risk correlation assumptions do not generally apply.

1d. Where ICCM Correlation Fails for RBC—Example

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Risk Theory Ideal (ICCM)

Company-specific correlation mode → homogeneous risk distributions.

[Company 1A] → LOB A (σ_A)

[Company 1B] → LOB B (σ_B)

↓ ↓
Combined in Risk Theory: ↓

[Company 2: A+B] → Combined Risk = $\sqrt{(\sigma_A^2 + \sigma_B^2 + 2\rho\sigma_A\sigma_B)}$

If correlation $\rho < 1$, diversification lowers total risk: **Risk(A + B) < Risk(A) + Risk(B).**

RBC Reality

Co	LOBs	LOB Risk Factors / Comment
1A	A only	LOB A = 5%—Specialist, lower risk
1B	B only	LOB B = 6%—Specialist, lower risk
2	A + B	LOB A = 6%, LOB B = 7%—Multi-line, higher indicated risk; correlation breaks

More generally, risk for any LOB can depend on insurer characteristics and the particular LOBs it writes.

1e. Our Calibration Framework is Like Ratemaking and Risk Classification

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Our Framework is more akin to Ratemaking and Risk Classification. We:

- Measure the extent to which companies writing more LOBs have lower indicated risk charges than companies writing fewer LOBs, “diversification.”
- Calculate the overall average credit for diversification.
- We allocate that credit to individual companies based on a reasonable method.

The “reason” companies writing more LOBs may have lower risk charges includes risk theory diversification, but may also include other variables, favorable or unfavorable, aligned with writing more LOBs, e.g., size, riskier sub-lines of business, geographic diversification, deeper controls, less specialization... The “reason” does not affect the indicated credit.

2. Apply IIA Before or After Diversification Credit

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Current:

Diversification Credit calibrated with data before IIA.

Diversification Credit applied after IIA

Alternative

No change

Diversification Credit applied before IIA.

Alternative requires a change to the Formula.
Alternative produces higher diversification credits/Lower RBC values
Alternative appears logical, but requires further research.

Impact

Item	Premium	Reserve
% Diversification Credit	39%	62%
% Risk Charge	-7%	-11%
% Reserve/Premium	-1%	-2%

3. Calibration Safety Level

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Adopting an increase in the indicated MDCs reduces the implied safety level in RBC Values.

We do not measure that reduction nor determine whether the total RBC is appropriate for regulatory purposes. That is beyond the scope of this Report.

Adopting a change to the RBC Formula implies an NAIC assessment, possibly judgmental, that the resulting safety level remains appropriate, and that no offset is required.

Note: Since the implementation of the RBC Formula, some changes have increased the implied safety level (e.g., RCAT set at the 1-in-100 safety level and the addition of the operational risk charge at 3% of RBC); Other changes decreased the implied safety level (e.g., reduced fixed income risk charges for assets and reduced reinsurance credit risk charges).

About the Academy

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Questions?

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