



Insurance Linked Securities Hedging Casualty Insurance Risk

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Agenda

- Market for Casualty Insurance Linked Securities
- Calendar-Year Loss Trend: the Link
- Systemic Risk: the Domain of ILS Products
- How ILS Products May Yield Capital Savings
- Conclusion

Market for Casualty Insurance-Linked Securities

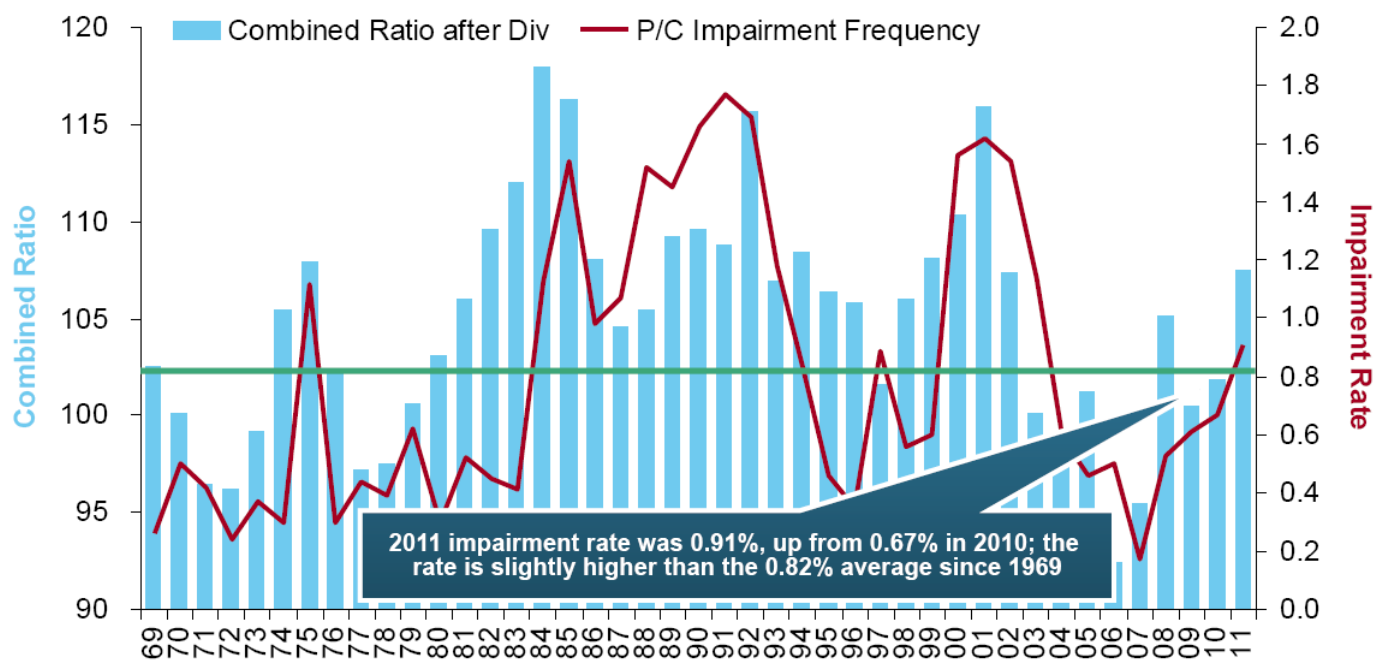
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Demand for Casualty *ILS Products*

- Insurance-linked securities are often used to hedge an insurer's exposure to catastrophic *property* losses.
- Why not utilize a similar strategy to hedge exposure to systemic casualty shocks?
- A casualty shock is the casualty analog to a property cat
 - the insurer's actual losses from some catastrophic change and the value of an industry index incorporating the same change should be correlated (not only for property lines).
- There exists significant market demand for products that can hedge exposure to casualty systemic risk (e.g. medical inflation).

Demand for Casualty *ILS* Products Insolvency Risk Has Strong Systemic Component

P/C Insurer Impairment Frequency vs. Combined Ratio, 1969-2011



- The probability of impairment depends not only on variables intrinsic to a given company but also on what happens industry-wide or systemically.
- The ability to withstand systemic shocks varies from company to company and can be assessed using variables such as company size, capitalization, line-of-business diversification, etc..

Source: Insurance Information Institute

Index-Based Covers

Advantages and Disadvantages

- Publicly available indices.
 - For example, ISO's Casualty Index TM product is available for "10 well-defined liability segments"
 - Guy Carpenter's CasReDexSM
- Moral hazard dramatically reduced or eliminated
 - To the extent index is outside of the control of the purchaser
 - Expands universe of potential risk takers
 - Offers product diversification potential to non-casualty writers without the need for extensive infrastructure
- Lack of coverage dispute
- Disadvantage is basis risk

Supply of Casualty *ILS Products*

- Developing an effective hedge for casualty lines which appeals to investors is more challenging than for property.
- In theory, a property cat will be substantially uncorrelated with other investments; however, this may not be the case for casualty business.
- The long tail of casualty business makes post-event estimation and settlement challenging.
- Collateralization of the limit over a longer term can be extremely expensive.

Stumbling Block (Illustration)

- For illustration, assume:
 - A cat bond pays principal and interest contingent upon the value of a “casualty index” remaining below a predefined threshold or index trigger.
 - If the casualty index exceeds the trigger, some or all of the collateral is used to pay the ceding company, resulting in loss of principal and/or interest to the bondholder.
 - Index is (by definition) the accident year 2013 loss ratio for a basket of companies (a random variable).
 - Index trigger is set to the 99th percentile of the Index distribution.
 - Issue date is 1/1/2013 and the maturity date is 12/31/16. Thus the value of the Index at settlement corresponds to an AY 2013 loss ratio at 48 months.
- Discussion:
 - Technically, this is not a multi-year exposure—although a substantial period of time is needed for the loss ratio index to sufficiently approximate ultimate.
 - What is the additional cost of the settlement lag? With collateral?

Calendar-Year Trend: the Link

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Calendar-Year Trend

- Calendar-year loss trend is the link between an insurance company's portfolio and the industry index underlying the hedge.
- A substantial change in the calendar-year trend will induce a significant mismatch between the actual future calendar-year trend time series and that assumed, implicitly or explicitly, in pricing and reserving.
- A common calendar-year loss trend will impact both the company's underwriting results and the casualty index causing both to move in sync.
- **It is this induced correlation that makes hedging feasible for casualty lines.**

Calendar-Year Trend

Industry data for casualty line, incremental paid losses \$ millions

	0	1	2	3	4	5	6	7	8	9
1998	4,645	4,927	3,016	1,485	1,172	806	594	438	316	316
1999	4,205	5,412	3,114	1,865	1,018	584	532	447	356	
2000	4,543	5,800	3,335	1,867	1,145	641	596	471		
2001	4,546	5,773	3,414	1,858	738	443	488			
2002	4,253	5,258	3,002	1,650	1,106	614				
2003	4,273	5,177	2,938	1,748	1,145					
2004	4,624	5,174	2,675	1,661						
2005	4,865	5,082	2,843							
2006	5,130	5,594								
2007	5,212									

Accident Year (AY) 2002

Calendar Year of Payment (CY) 2007
(CY = AY + DY)

Development Year (DY) 1
Payments made in the year after the accident year

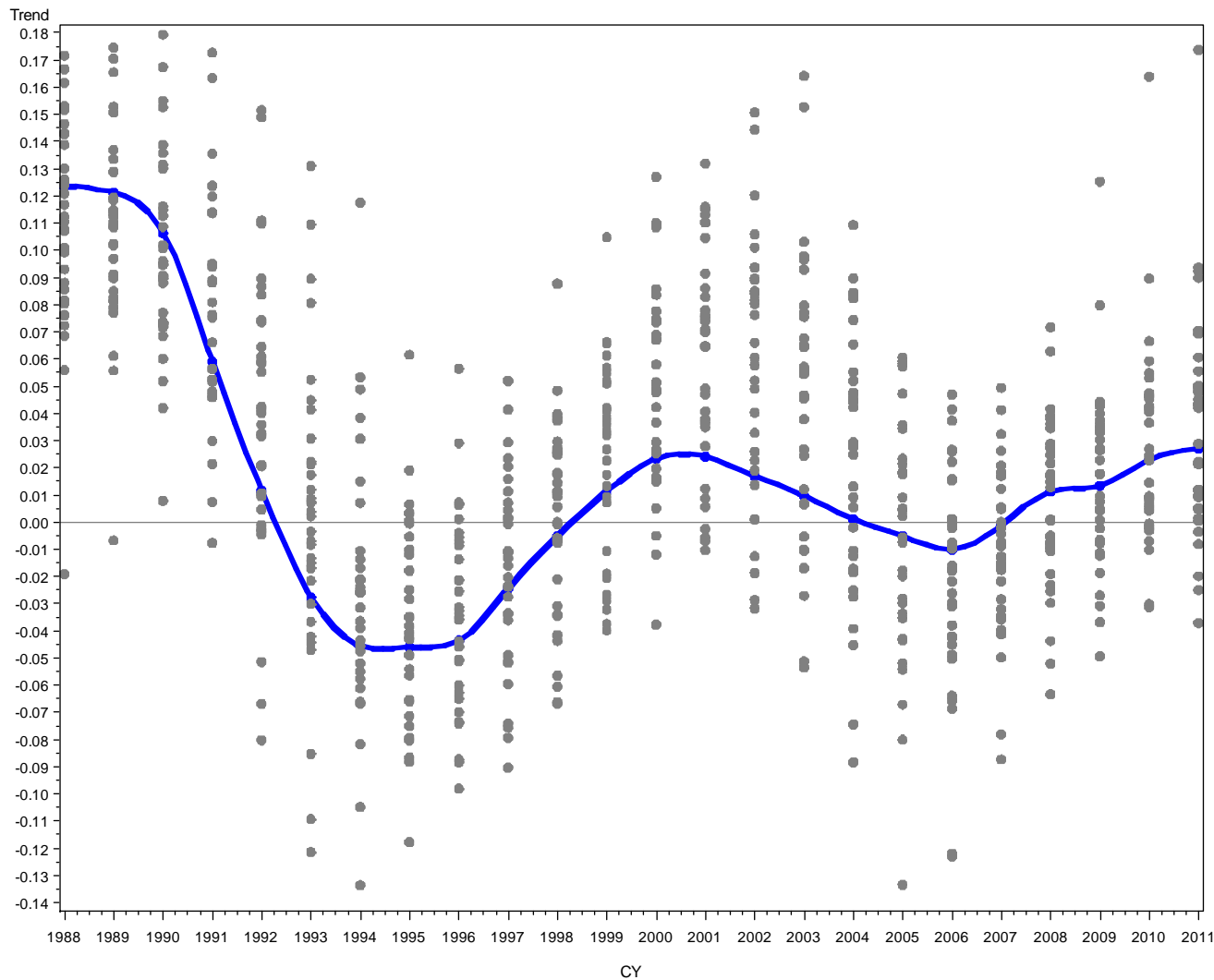
The often-neglected calendar year direction is the key. Changes in the calendar year trend can have a profound impact on future loss development.

Sources of Changing Calendar-Year Trend

- **Aggregation risk** – an exposure concentration affecting similar types of risks or a particular coverage involving multiple accident years arising out of a particular product, substance or some common causative factor such as a design, business activity, error or omission
- **New legal theory** or coverage interpretation – such as might be found in the Keene Corporation or Montrose Chemical of California decisions
- Liability arising out of a relatively **new or existing product or technology**
- **Change in macroeconomic conditions** – such as medical inflation driven by a costly new technology or unforeseen cost shifts associated with universal health insurance
- **Changes in regulatory environment**
- **Other unforeseen causes** (the “unknown unknowns”)

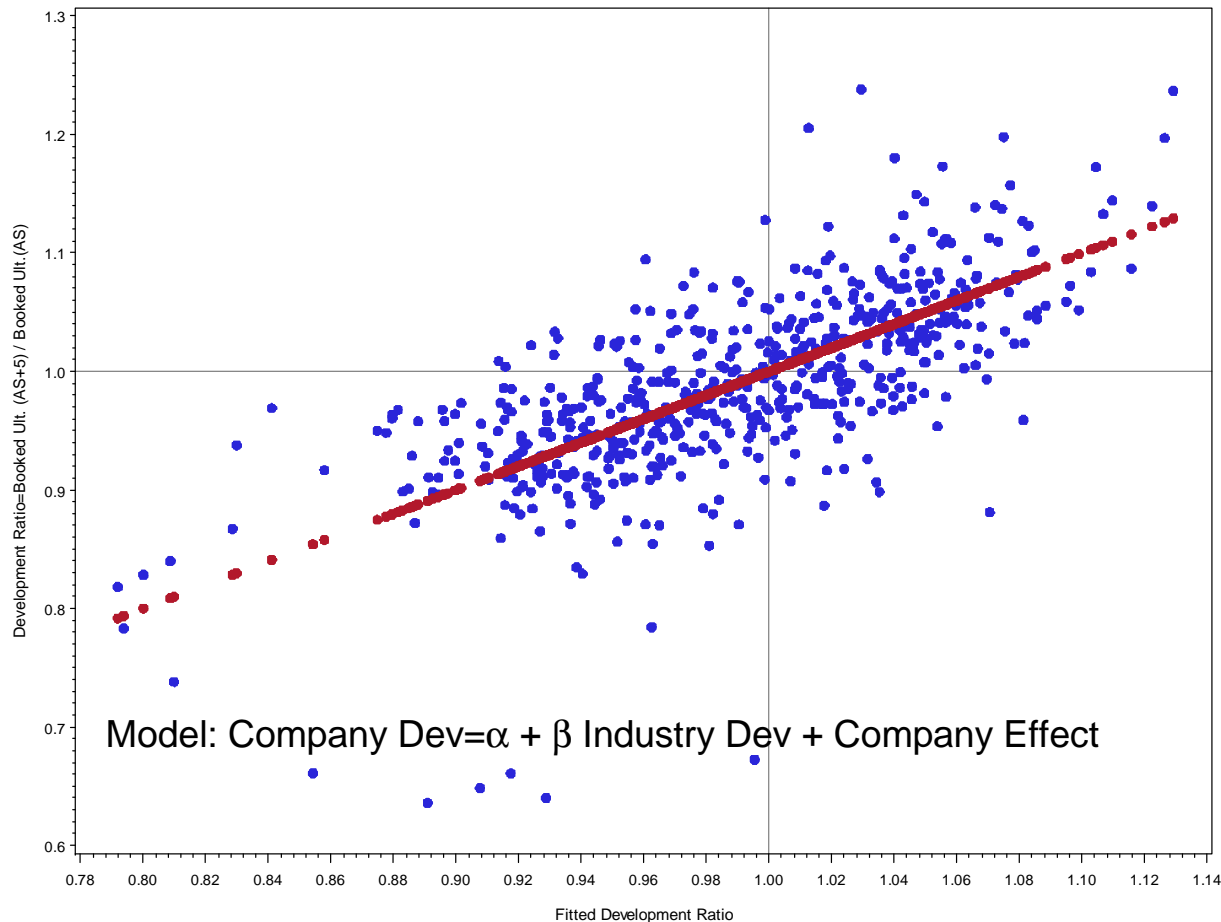
Estimation of Calendar-Year Trend

Separating the Signal from the Noise



- GLM fit to company incremental payments yields estimated CY trend rates.
 - Single casualty line
 - For illustration only
 - Each point corresponds to a CY trend estimate for an individual company.
- Signal-to-noise ratio improves with filtering and pooling.
 - Blue curve represents estimated CY trend derived from pooled data.

Common Calendar-Year Trends Induce Correlation



- Compare booked ultimate (including IBNR) losses by Annual Statement Year to estimates five years later (with the benefit of hindsight).
 - Blue dots represent individual companies
 - Red dots represent what would be expected based on the overall development of the “industry”.
- Note: Assumed 10th report losses are ultimate.

Systemic Risk: the Domain of ILS Products?

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Why it Makes Sense to Focus on Systemic Risk

- A component of casualty insurance risk is idiosyncratic or firm-specific and cannot be hedged using broad-based industry indices. Such risk is within the domain of traditional reinsurance.
- Perhaps focus should be on developing products for hedging just the systemic component of insurance risk. Indices suited for this purpose.
- A systemic casualty shock will typically impact both prospective business and reserves on prior accident years. Business on the books for years and perceived to be profitable can suddenly go sour.
 - Systemic risk is a significant factor in pricing/reserving errors.
 - Systemic risk is increasingly on the radar screen of ratings agencies and regulators (e.g. Best's SRQ)
- Index-based covers can be used to “carve out” systemic risk.

Illustration: The Double-Whammy

- Interestingly, the risk of insolvency increases with increasing interest rates and with the duration of the insurer's bond portfolio*.
- Since calendar-year loss trend incorporates a component of inflation, which is highly correlated with interest rates, a period of dramatically increasing interest rates may coincide with increasing loss trend.
- Double whammy impacting both sides of the balance sheet:
 1. interest rates rise → reducing the value of the bond portfolio, and
 2. inflation increases → systematic pricing/reserving errors.
- Result is a simultaneous drop in the market value of the bond portfolio on the asset side and a trend-driven reserve correction on the liabilities side. The impact on economic surplus would be leveraged.

Illustration: The Double-Whammy

- Given for ABC Insurance Company:
 - Ratio of outstanding loss to surplus, $O/S=1.00$
 - Average payment lag on reserves, $L=5$ years
 - Bonds to surplus ratio, $B/S=2$
 - Bond portfolio duration, $D=4$
- How would ABC weather a permanent 1% increase to the trend rate coinciding with a 1% shift in the yield curve?

Illustration: The Double-Whammy

- The impact on surplus, S, is therefore:

$$\Delta S = \Delta B - \Delta O$$

$$\Delta S \approx -BD \Delta i - OL \Delta i$$

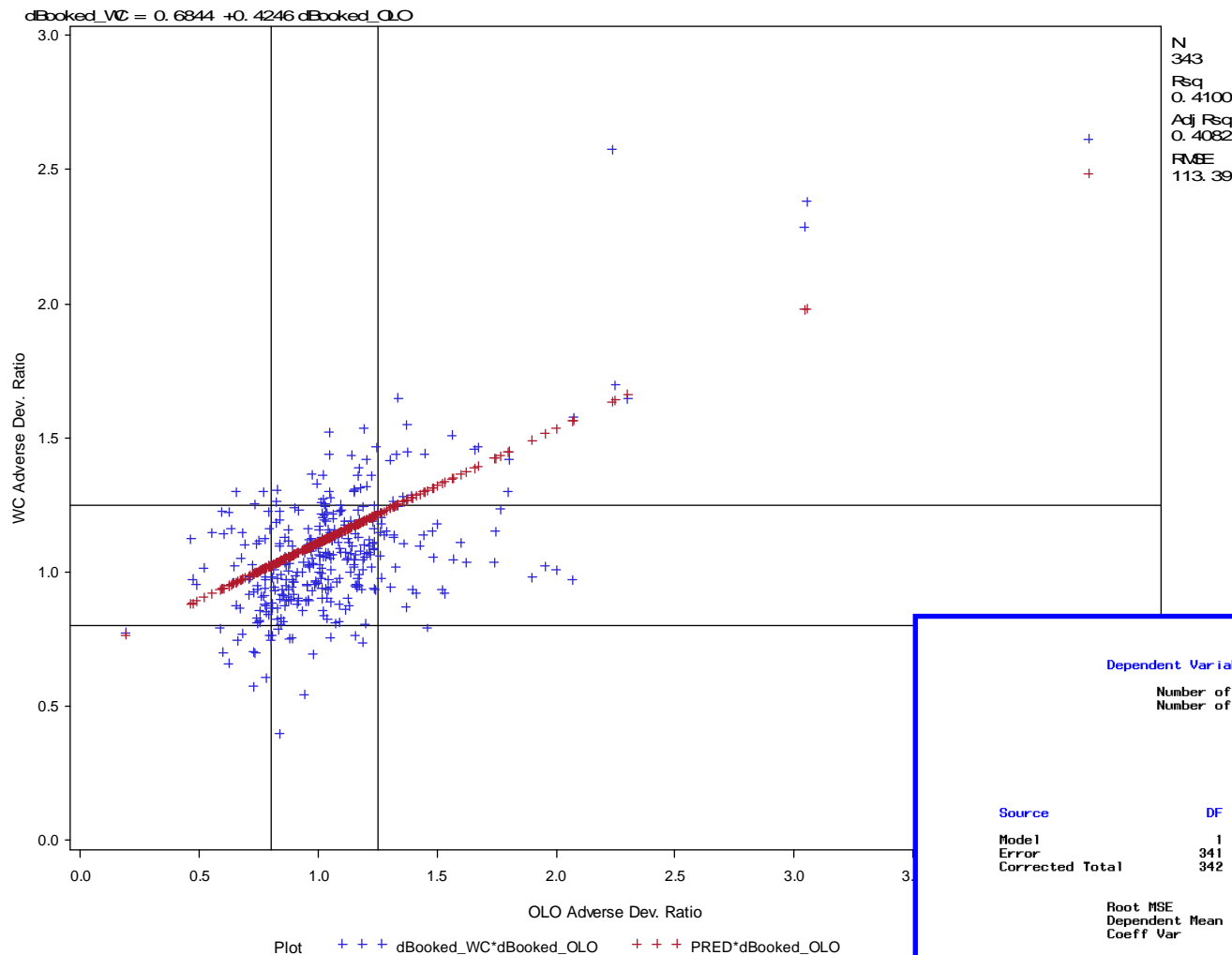
$$\Delta S \approx -(OL + BD) \Delta i$$

$$\Delta S/S \approx -\{(O/S)L + (B/S)D\} \Delta i$$

$$\Delta S/S \approx -\{(1)5 + (2)4\}(.01) = -13\%$$

- Similar to how an interest rate risk stress test might incorporate the company's exposure to catastrophic property loss.
- Systemic risk is increasingly on the radar of ratings agencies and regulators. Best's Survey Response Questionnaire (SRQ) now asks whether the company has estimated the sensitivity of net reserves to potential changes in general inflation.

Adverse Development Correlated Between Lines Over Five Year Development Period (Annual Statement Years 1998 to 2004)



- When a company's *booked* Workers Compensation (WC) reserves develop adversely, their Other Liability—Occurrence (OLO) will also tend to develop adversely.
- R^2 is 41%
- Based on a sample of companies with at least \$10M of WC and \$10M of OLO Reserves at start of AS Year.
- Excludes post-10th report development.

The REG Procedure
Model: MODEL1
Dependent Variable: dBooked_WC Adverse Dev. Ratio

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3046313	3046313	236.92	<.0001
Error	341	4384555	12858		
Corrected Total	342	7430868			

Number of Observations Read 343
Number of Observations Used 343

Weight: wt

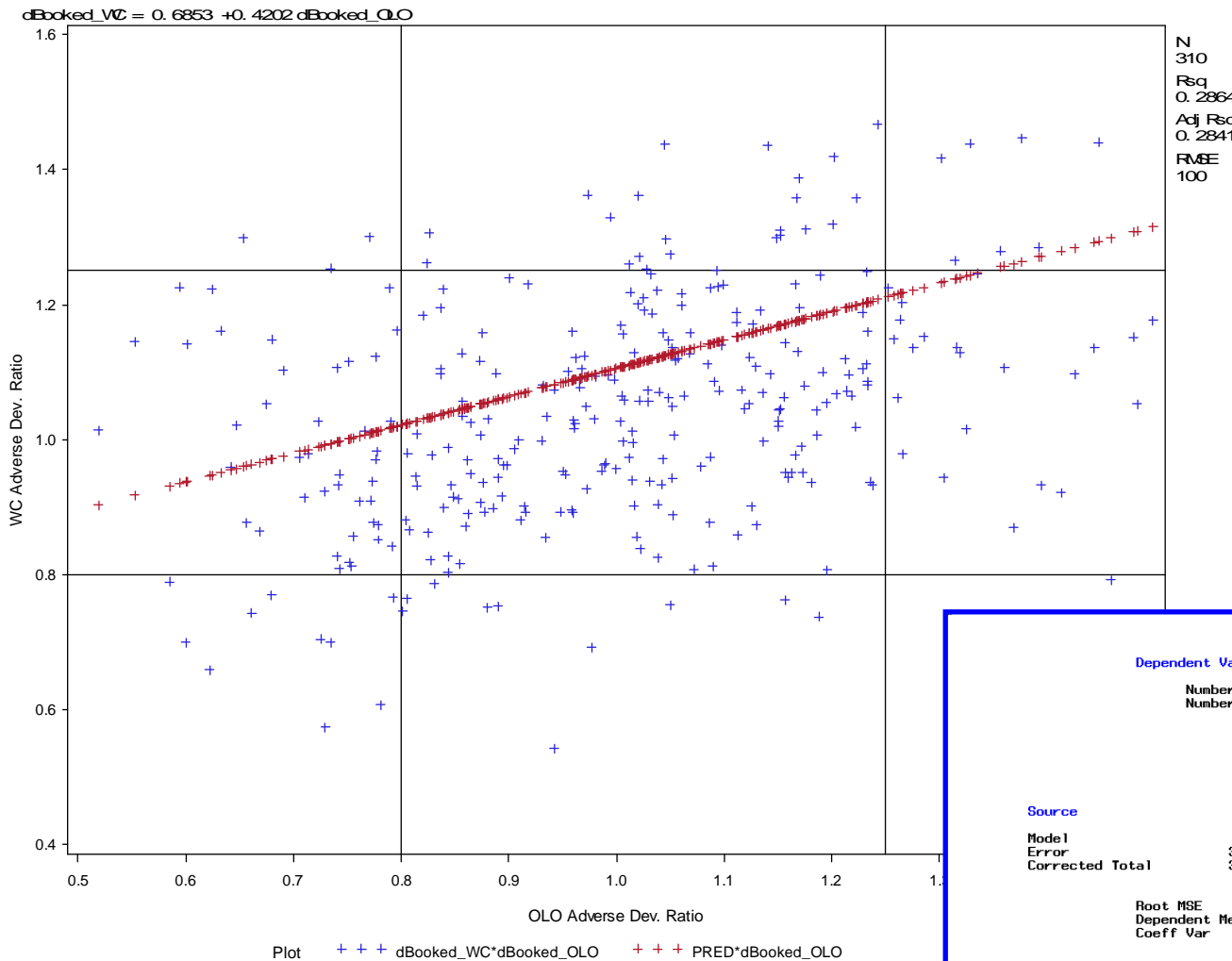
Analysis of Variance

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	Intercept	1	0.68439	0.03259	21.00	<.0001
dBooked_OLO	OLO Adverse Dev. Ratio	1	0.42456	0.02758	15.39	<.0001

Root MSE 113.39282
Dependent Mean 1.17218
Coeff Var 9673.66548

R-Square 0.4100
Adj R-Sq 0.4082

Adverse Development Correlated Between Lines Over Five Year Development Period (Annual Statement Years 1998 to 2004)



N
310
Rsq
0.2864
Adj Rsq
0.2841
RMSE
100

- To check whether the results are being overly influenced by outliers, we exclude 33 data points for which booked reserves change by more than 50%.
- Correlation is still statistically significant, 29%.
- Based on a sample of companies with at least \$10M of WC and \$10M of OLO Reserves at start of AS Year.
- Excludes post-10th report development.

The REG Procedure
Model: MODEL1
Dependent Variable: dBooked_WC WC Adverse Dev. Ratio

Number of Observations Read	310
Number of Observations Used	310

Weight: wt

Analysis of Variance

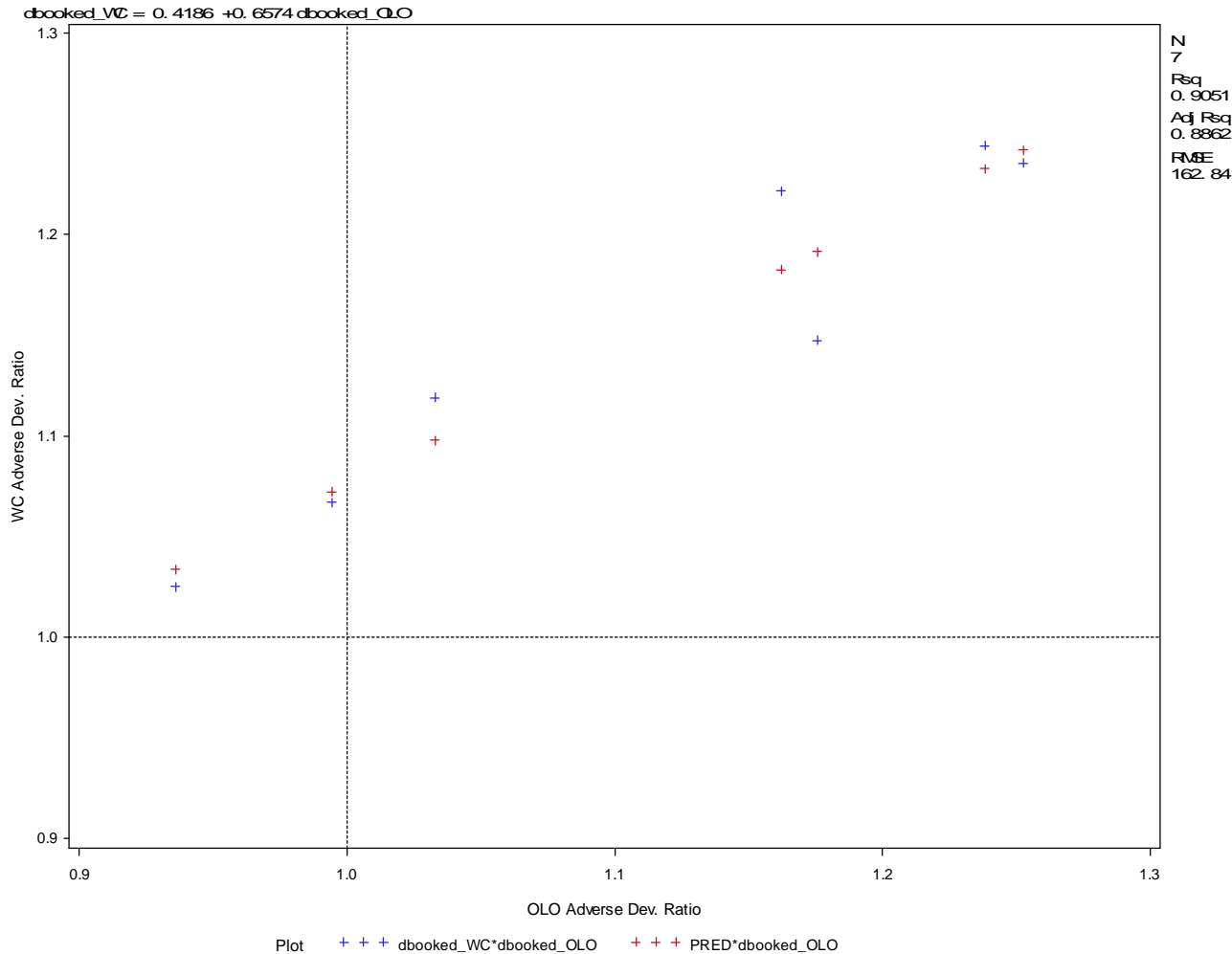
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1236274	1236274	123.62	<.0001
Error	308	3080124	10000		
Corrected Total	309	4316398			

Root MSE	100.00202	R-Square	0.2864
Dependent Mean	1.14387	Adj R-Sq	0.2841
Coeff Var	8742.40799		

Parameter Estimates

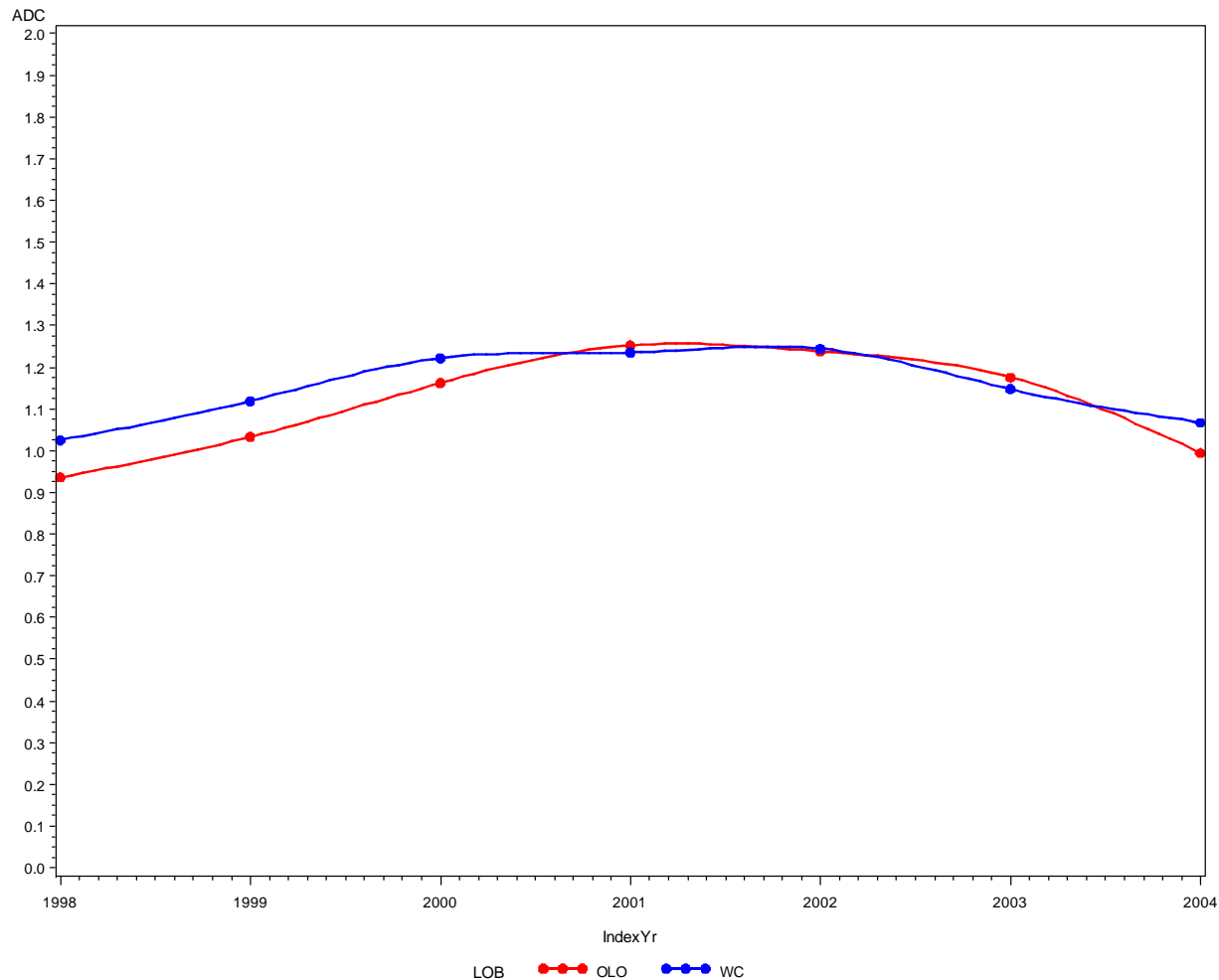
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	Intercept	1	0.68527	0.04185	16.38	<.0001
dBooked_OLO	OLO Adverse Dev. Ratio	1	0.42020	0.03779	11.12	<.0001

Adverse Development Correlated Between Lines Over Five Year Development Period (Annual Statement Years 1998 to 2004)



- When aggregate booked Workers Compensation (WC) reserves develop adversely, aggregate Other Liability—Occurrence (OLO) will also tend to develop adversely.
- Aggregation “diversifies away” much of the company-specific noise.
- R^2 is 90%.
- Aggregates based on a sample of companies with at least \$10M of WC and \$10M of OLO Reserves at start of AS Year.
- Excludes post-10th report development.

Adverse Development Correlated Between Lines (Aggregate) Over Five Year Development Period (Index Years 1998 to 2004)



- At the individual company level the correlation between WC and OLO is modest but statistically significant.
- However, as an insurer's portfolio become more diversified and the impact of idiosyncratic risk is dampened, the correlation between the two lines should become more pronounced.
- “Risk is co-dependence”

How ILS Products May Yield Capital Savings



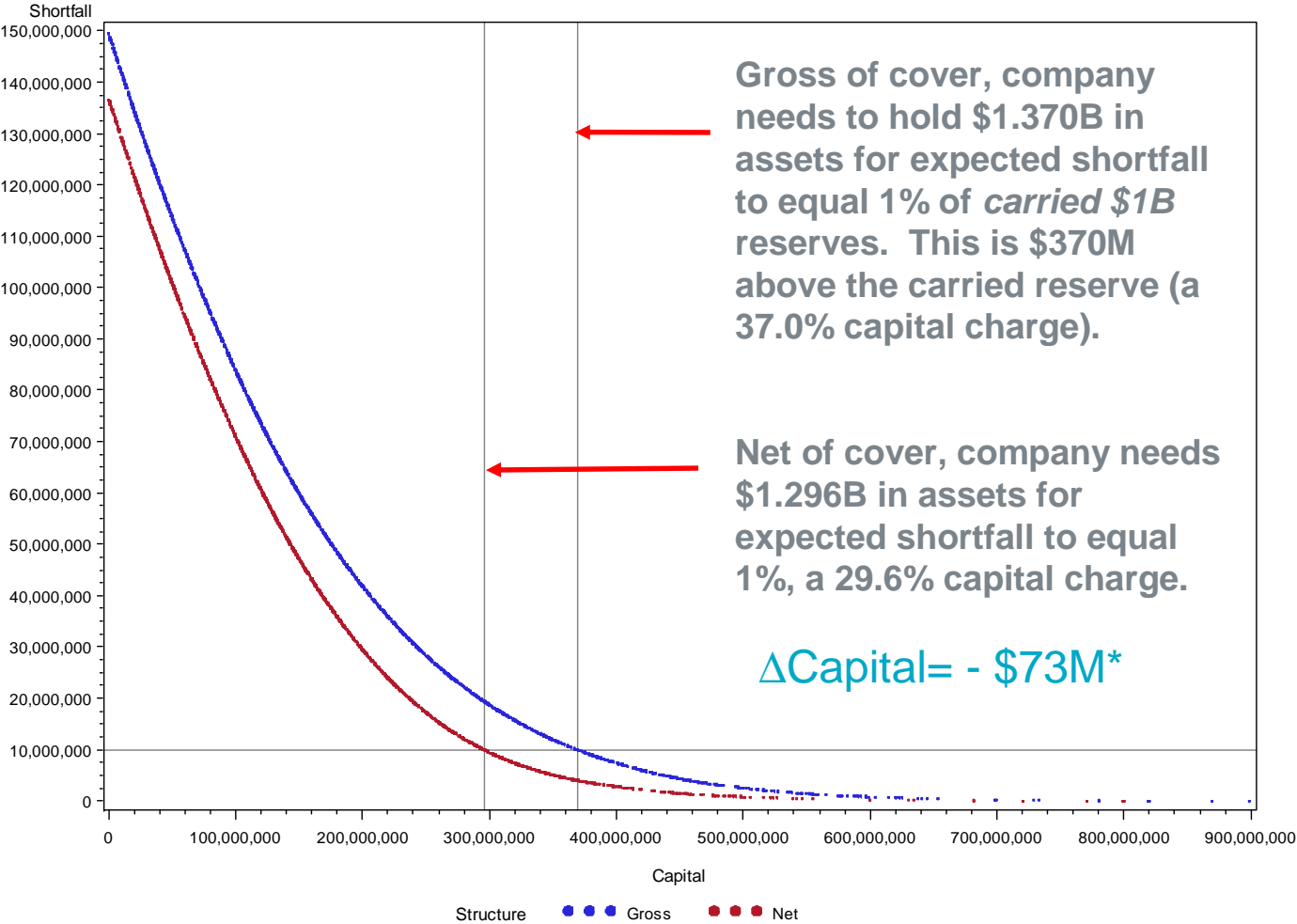
Why Develop a Systemic Risk Cover?

- Inadequate reserves remain one of the leading causes of financial impairment for P&C insurers.
 - Systemic risk is a significant factor in adverse reserve development.
- Possible reduction in underwriting capital
 - In setting stand-alone capital, an insurer might ask: “how much capital do I need to weather a 1-in-100 windstorm or a 1-in-250 quake?”
 - The same insurer might ask: “how much capital do I need to weather a systemic shock corresponding to 1-in-50 trend scenario?”
 - In both cases, needed capital is set with respect to some stress scenario or tail event.

Possible Reduction in Rating Agency Required Underwriting Capital Stand-Alone Reserve Capital Set to Stress Scenario

Capital Needed for 1% Expected Shortfall

Capital Reduction: 73,407,993 (Gross Capital - Net Capital)



Scenario: Volatility Adjustment=2, CPI Drift=.02, Change in Medical Spread=0, Change in WC Trend Spread=0

Conclusion

The image features a dark blue background at the top. Below it, there are several horizontal bands of varying shades of blue and teal. The top band is dark blue and contains the word "Conclusion" in white. The next band is a lighter teal. This is followed by a thin, light blue band. The bottom band is a medium teal. The boundaries between these bands are wavy and irregular, creating a layered, abstract effect.

Conclusions

- There is demand for ILS casualty products. However, the longer settlement lag associated with casualty business and the partial correlation with the overall economy make it more challenging to find risk takers.
- ILS products are perhaps better suited for hedging systemic casualty underwriting risk as opposed to underwriting risk that is idiosyncratic or firm-specific. Systemic underwriting risk is resistant to diversification by line or state and is even correlated with the asset side of the balance sheet.
- Actuarial methods implicitly or explicitly assume a future calendar year loss trend time series. A substantial change in the calendar-year trend will induce a significant mismatch between the actual future calendar-year trend time series and that assumed in pricing/reserving.
- The success of ILS products will also likely depend in part on how much capital/ERM credit rating agencies and regulators grant.

