Institute and Faculty of Actuaries

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Forecasting Underwriting Cycle: A wild goose chase or a quantum leap?

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Chapter I

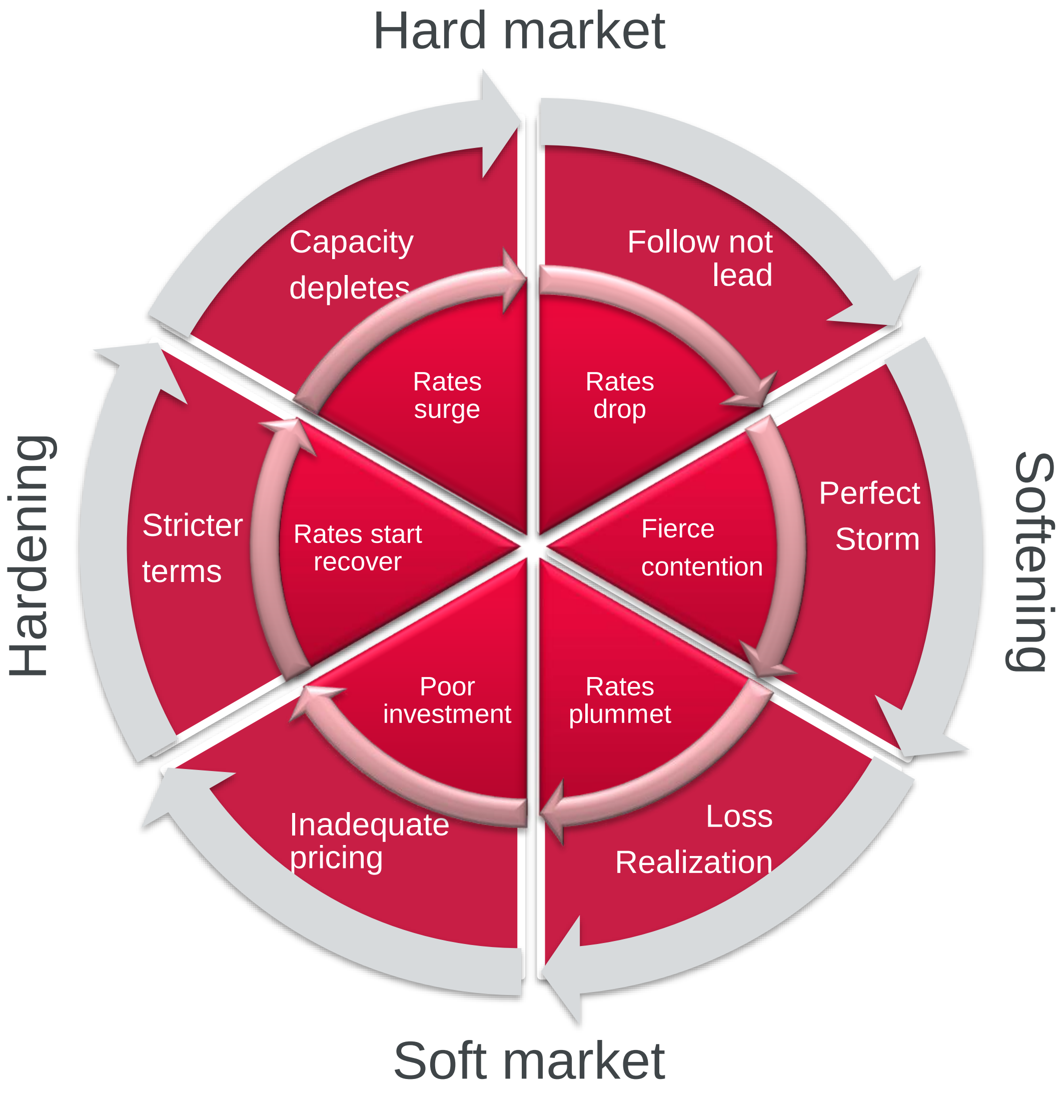
Look at market fluctuations as your friend, rather than your enemy.

Photo credit : https://www.gatesfoundation.org

Insurance clock – what time is it?

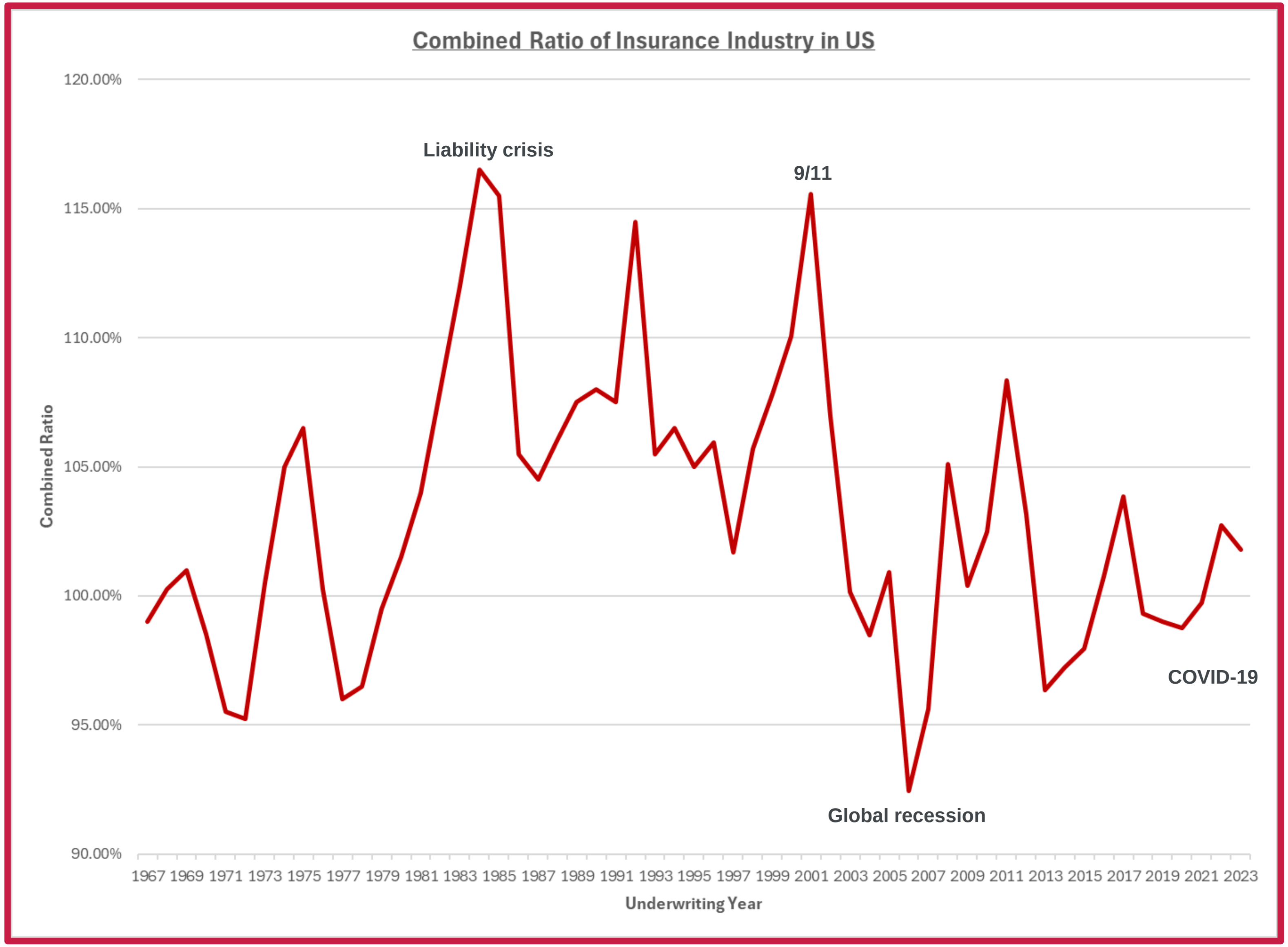
- At 12 pm, there is a euphoria in the market as the profits are high
- At 6 pm, there is a depression in the market as the profits are low
- It's about 2 pm now and we are staring at a looming sunset!

Underwriting/insurance cycle – from the inside out



- Low barriers to entry
  - ease with which new entrants join insurance markets
- Simplistic capital regime
  - capital required depended on the premium
- Delay until profitability is known
  - the delay between writing and knowing how profitable
- Economies of scale
  - encourages marginal costing ; little or no cost saving
- Capacity constraint theory
  - Dynamic relationship between pricing and surplus

Combined ratio – a proxy for the cycle



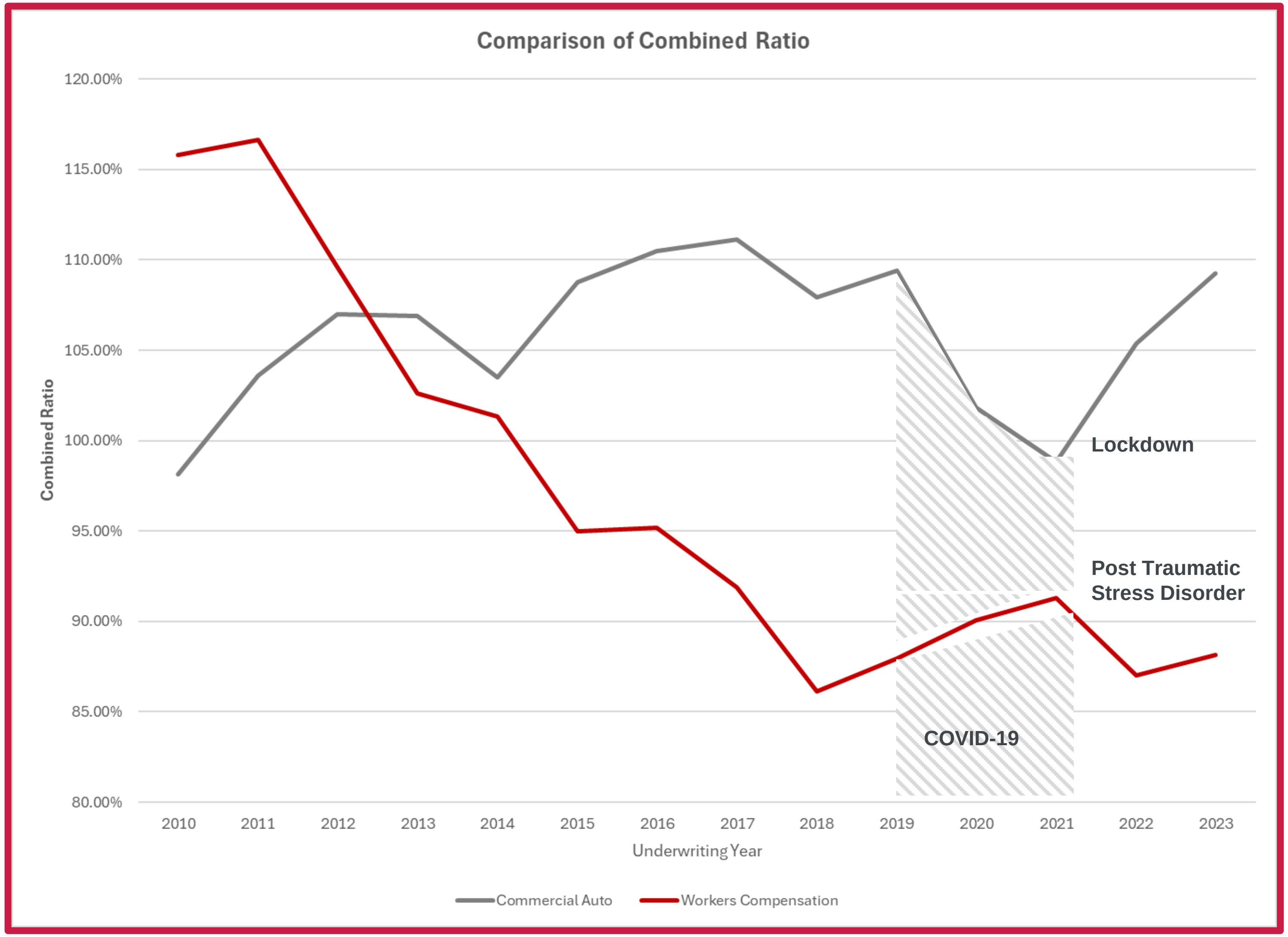
Period	Peak/Trough
	1969 (Peak)
3	Hardening
	1972 (Trough)
3	Softening
	1975 (Peak)
3	Hardening
	1978 (Trough)
6	Softening
	1984 (Peak)
3	Hardening
	1987 (Trough)
5	Softening
	1992 (Peak)
5	Hardening

Peak/Trough	Period
Softening	3 and counting
2020 (Trough)	
Hardening	
2017 (Peak)	3
Softening	
2013 (Trough)	4
Hardening	
2011 (Peak)	2
Softening	
2006 (Trough)	5
Hardening	
2001 (Peak)	5
Softening	
1997 (Trough)	4

- It takes more years for prices to go down than to go up
  - On an average, softening period (4.5 years) is longer than period of hardening (3 years)

Data source: A.M. Best's Global Insurance and Banking Database

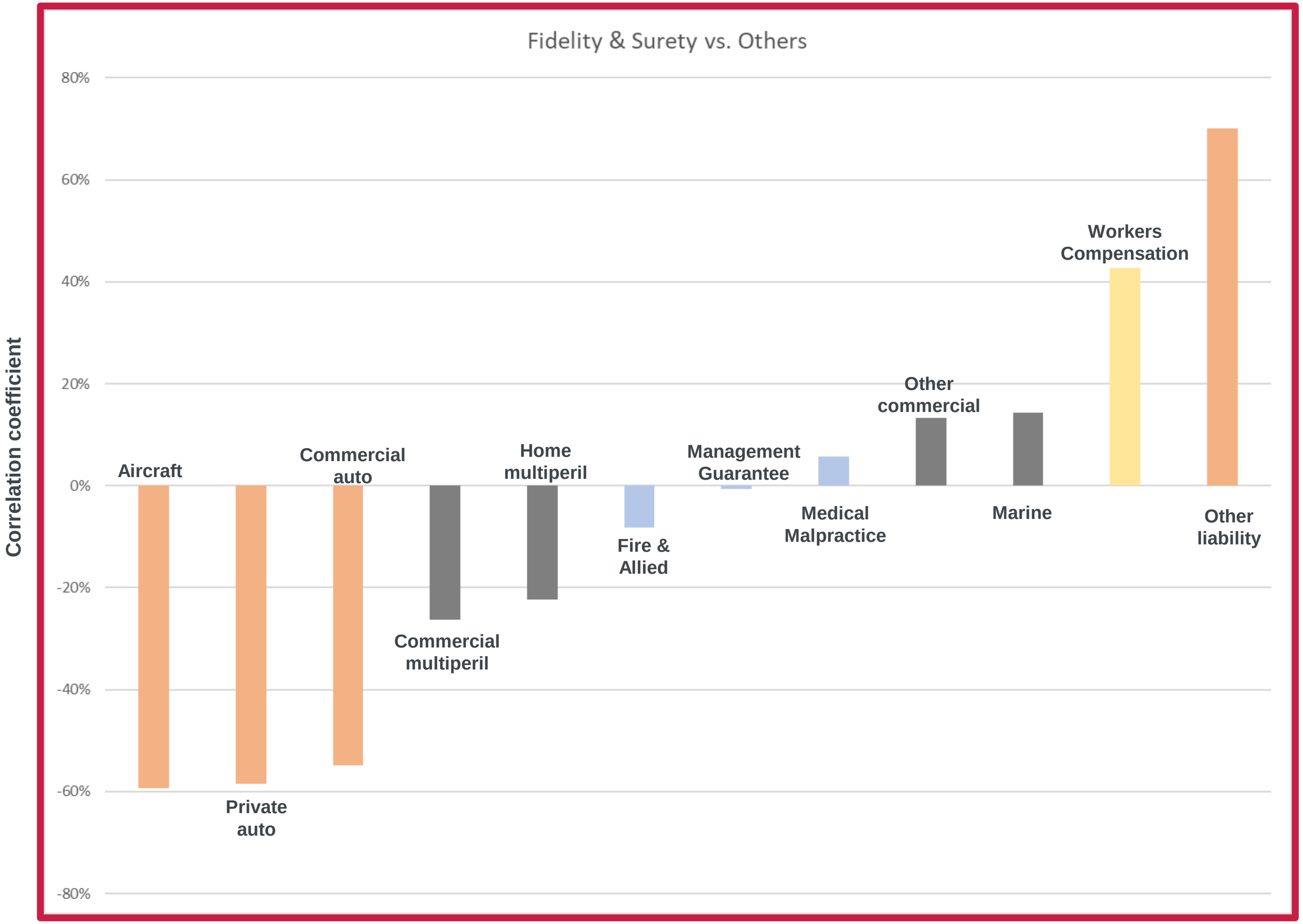
Commercial auto & Work Comp – in different time zones



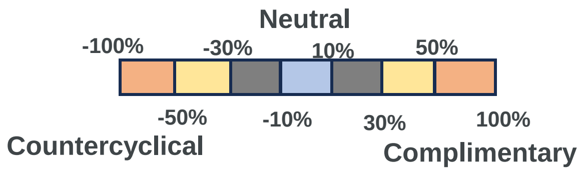
- Position in the cycle
  - different classes of insurance business will tend to be at different points of the cycle at different times
- Strategic decision
  - an insurer is aware of the position in the underwriting cycle of each of its classes of business when making strategic decisions
- Cross-subsidization of profit
  - at any point in time, profits from one class of business will subsidize another, less profitable, class

Data source: S&P Global Capital IQ Insurance Database

Fidelity/Surety – the neutralizer



- Resilience through diversification
  - The good news is that all the lines are not completely aligned to make things worse
  - Fidelity/Surety either bucks the trend or remains indifferent mostly with other portfolios.
  - Counter cyclical or mostly neutral with the dominant portfolios like Auto, Fire & Allied, Home, Medical Malpractice, Marine etc.
  - Growing such uncorrelated or cycle resilient portfolios can significantly help managing the cycle, specially at the bottom of the cycle



Data source: S&P Global Capital IQ Insurance Database

Chapter II

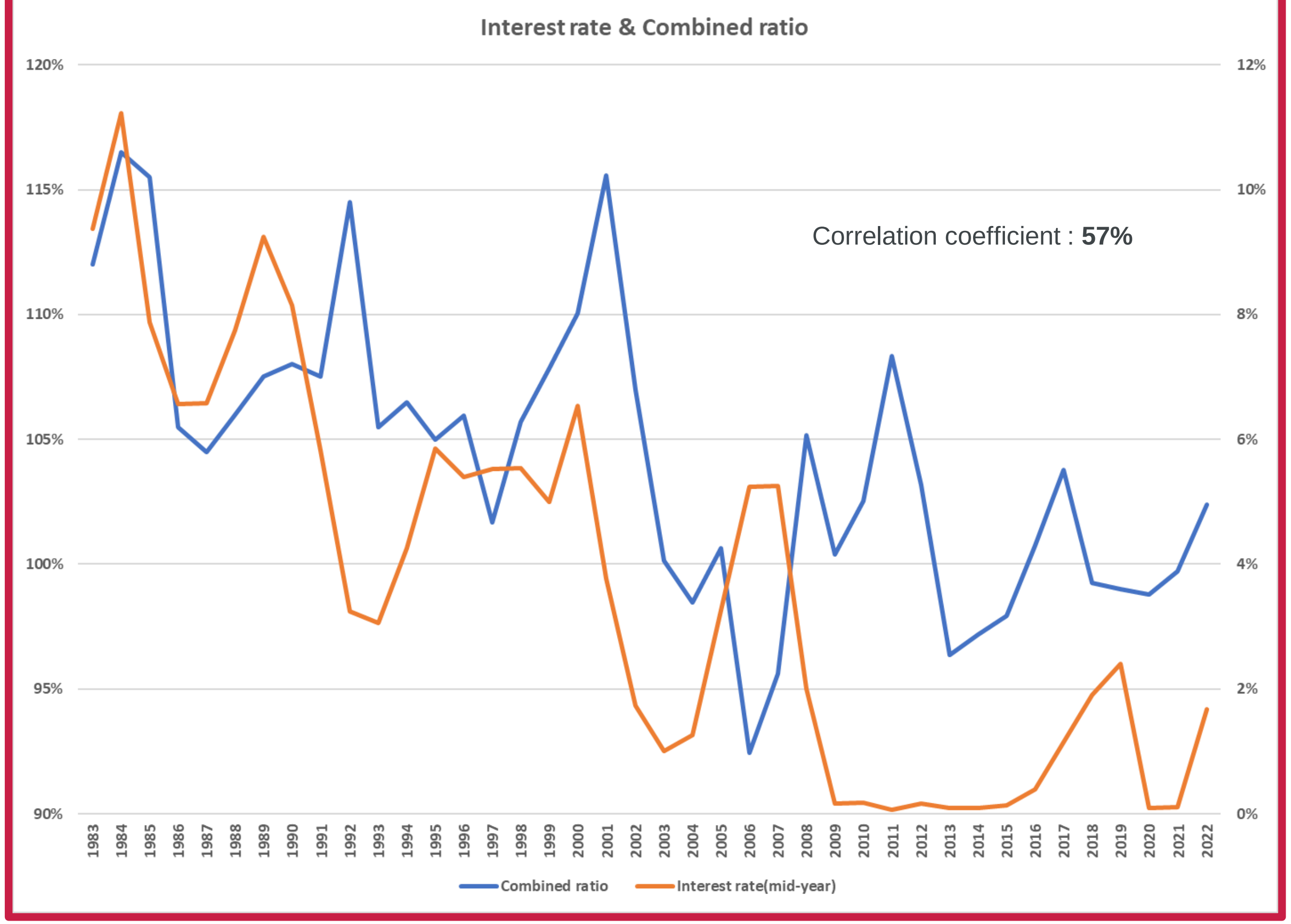
May the forces

(behind insurance price fluctuations)

be with you, always.

Photo credit : https://starwars.fandom.com

Interest rate – the adjuster



interest rate rises

investment opportunity cost increases; cost of missing out on an even better investment is greater

new investments through constant flow of premium

collect interest payment from previous bonds

new investments yield more than the previous one

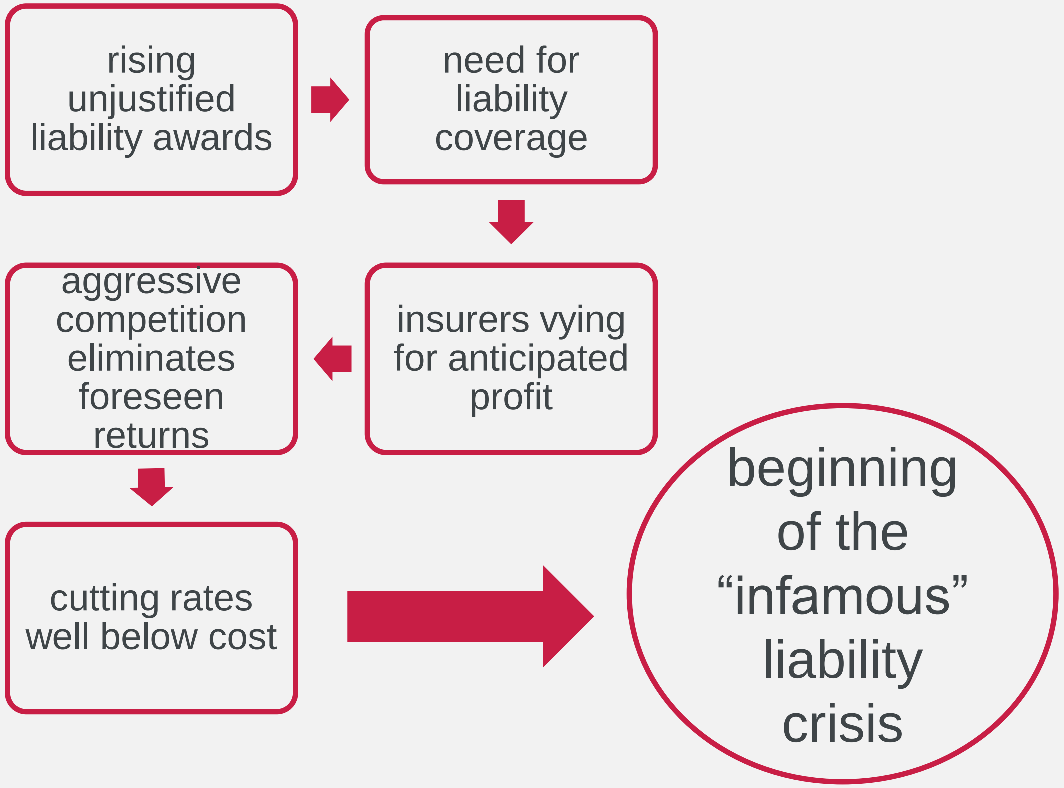
raises average yield ; increases interest income

lowering the rates ~ "cash-flow underwriting"

Data source: Statistica Research (https://www.statista.com)

Regulations and Legislations – the accelerators

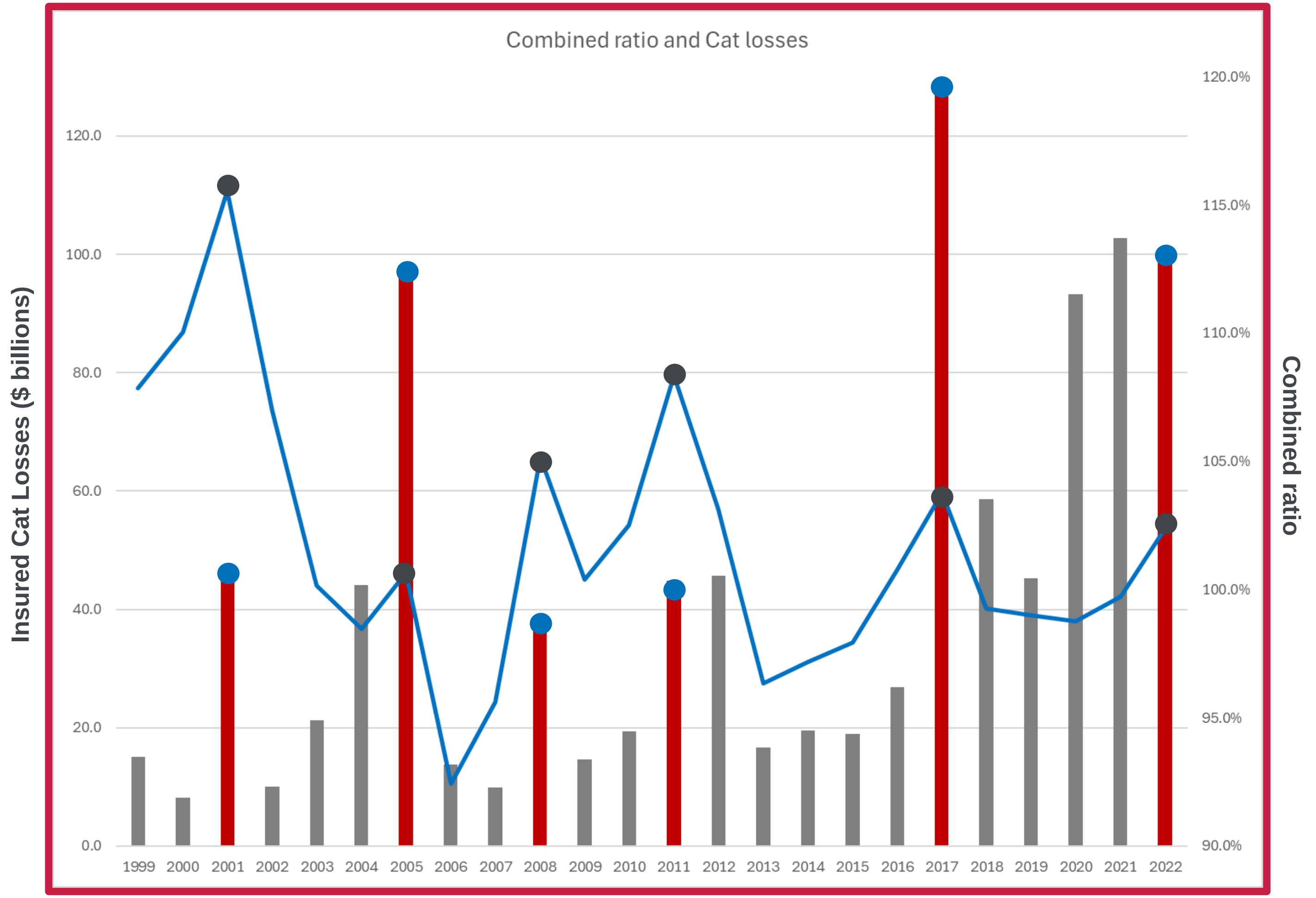
Favorable legal system hastens soft cycle



Regulatory regime influences the cycle

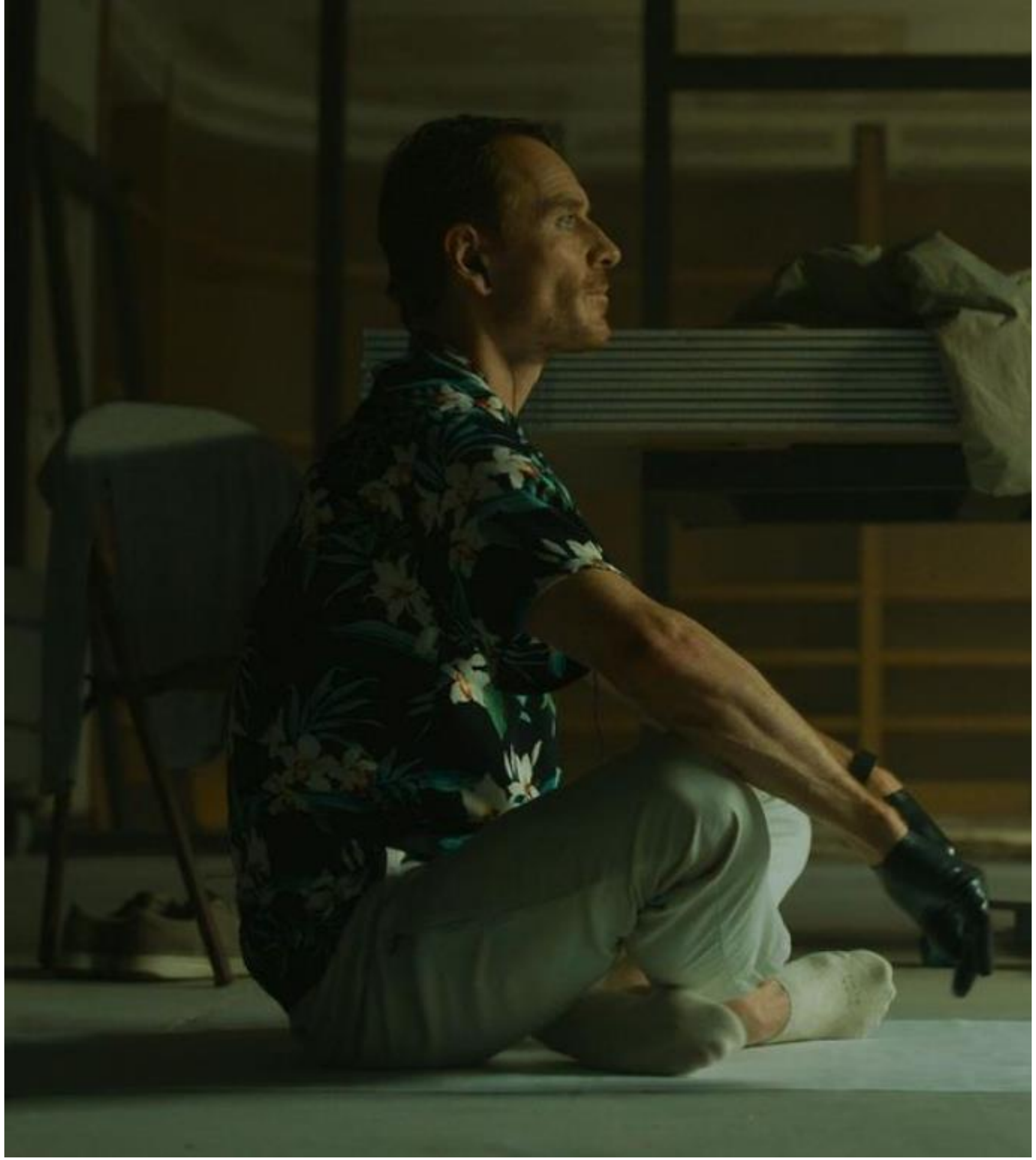
- Regulations vs Open Competition
  - Competitive rating laws allow more freedom to vary premium rates in attempts to gain market share or increase profits
- Delay in implementation
  - additional delays between the experience period and the effective date of application of the revised rates
- adequate, not excessive, not unfairly discriminatory
  - insurance rate regulation reduces the markup of average premiums over losses, hence the profit

Catastrophic losses – a perfect storm



- Catastrophic event hardens the market
  - The position of the soft cycle is accentuated by the catastrophes, like in 2001 (9/11), 2005 (Hurricane Katrina), 2008 (Hurricane Ike), 2011-12 (Hurricane Sandy), 2017 (Hurricane Harvey, Irma & Maria)
  - Catastrophic events give rise to "demand-surge"
  - At this point, some insurers leave or reduce their involvement in the classes concerned
  - Competition reduces; premium rates start to rise
- Cat modeling determines the "turn"
- The effect of catastrophic losses on the underwriting cycle is smaller than often assumed, and less so than in the past

Data source: Insurance Information Institute U.S. Natural Catastrophes archive



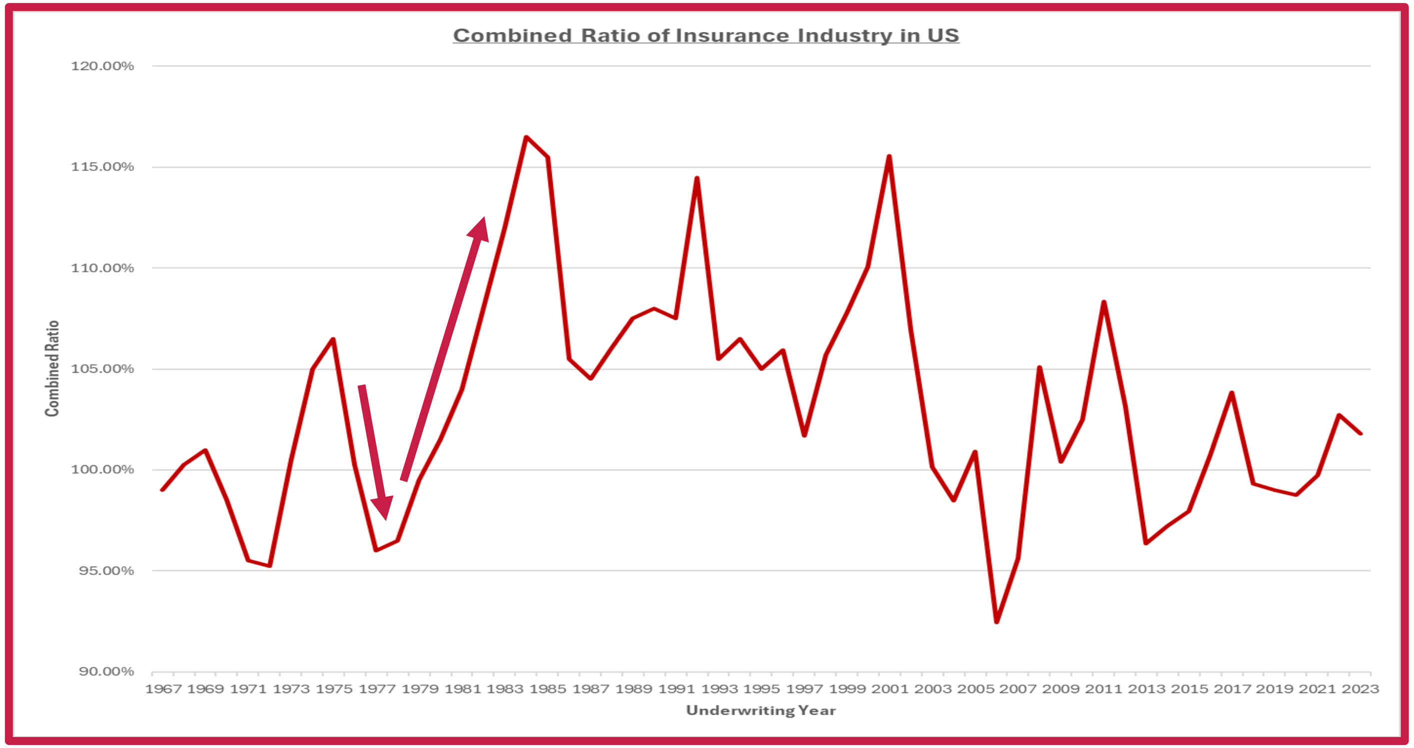
Chapter III

Anticipate.

Don't improvise.

Photo credit : "The Killer" ; Netflix

Behaviour of the cycle – search for a mathematical form



- A softening (DOWN) year generally tends to be followed by another softening year
- A hardening (UP) year generally tends to be followed by another hardening year

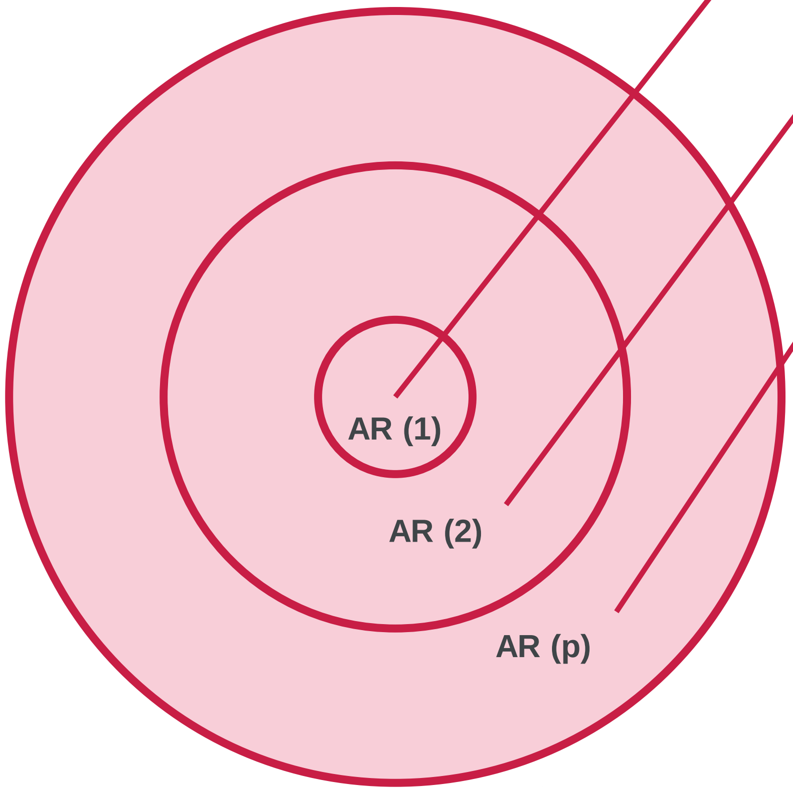
- There is some degree of auto-correlation present in the cycle
- More than 50 data points are recorded at an equidistant time interval (annual)
- An autoregressive time series model predicts current values based on a linear combination of past values, leveraging the inherent auto-correlation

Auto Regressive Integrated Moving Average – ARIMA

$$ARIMA\,(p,d,q)\ :\ \Delta y_t = c + \alpha_1 \Delta y_{t-1} + \ \ldots . + \alpha_p \Delta y_{t-p} + \theta_q \varepsilon_{t-q} + \ \ldots . + \theta_1 \varepsilon_{t-1} + \varepsilon_t$$

y_t = target ; y_{t-1} = lagged target ; α_p= AR coefficient ;
θ_q= MA coefficient ; $\mathcal{E}_t$= error term ; c = constant ; Δ = difference

$ARIMA\,(p,d,0)$



$\Delta y_t = c + \alpha_1 \Delta y_{t-1} + \varepsilon_t$

$\Delta y_t = c + \alpha_1 \Delta y_{t-1} + \alpha_2 \Delta y_{t-2} + \varepsilon_t$

$\Delta y_t = c + \alpha_1 \Delta y_{t-1} + \ \ldots . + \alpha_p \Delta y_{t-p} + \varepsilon_t$

- Lagged values are statistically significant with most recent value
- Stationarity
  - mean constant over time
  - correlation structure constant over time
  - differencing for trend stationary
- (Partial)Auto Correlation Factor
- Akaike Information Criteria
- Train & test data validation

ARIMA + eXogeneous – ARIMAX (the "X factor")

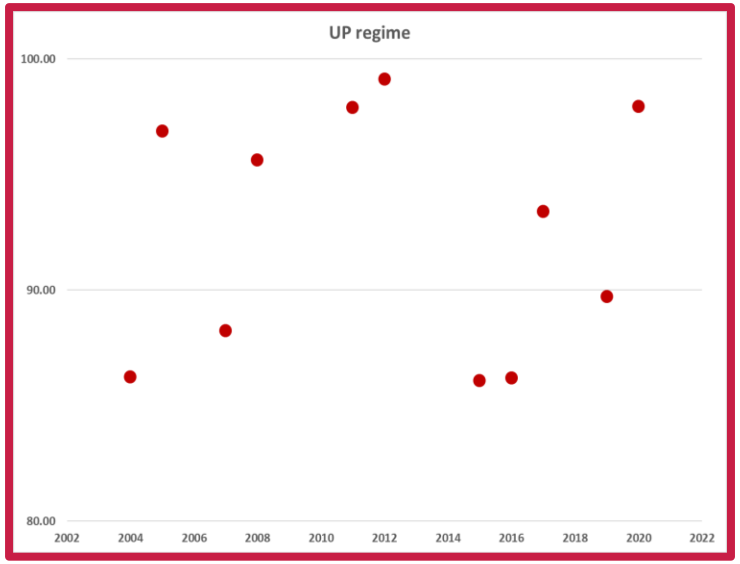
$$ARIMAX\,(p,d,0):\ \Delta y_t = c + \beta X_t + \alpha_1 \Delta y_{t-1} + \ \ldots + \alpha_p \Delta y_{t-p} + \varepsilon_t\,;$$

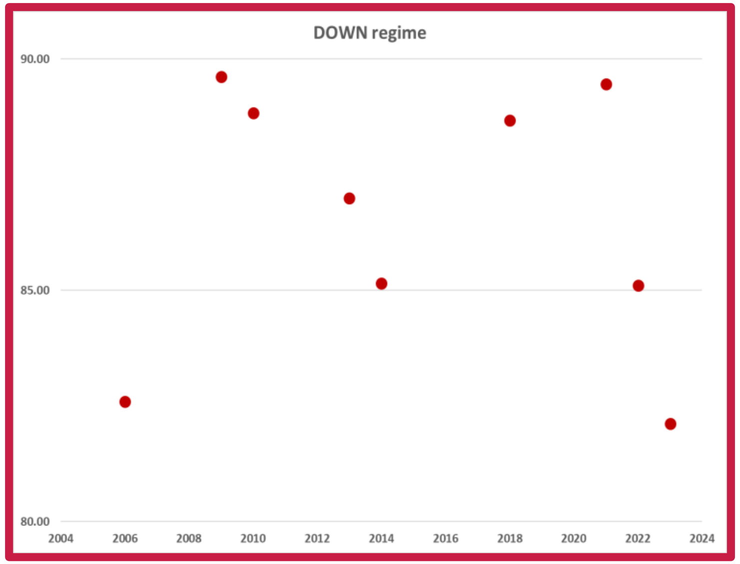
X_t = Exogeneous variable (e.g., interest rate)

- Competition
- Economy
- Regulations
- Product Pricing

- Multivariate extension of the ARIMA
- Multiple regression model to forecast dependent variable (Y),
  - Unlagged independent variable (X)
  - Lagged dependent variable (Y)
  - Error term ($\mathcal{E}$)
- Ability to incorporate external variables and provide more robust and accurate forecasting
  - macro economic variables like interest rate
  - environment variables like natural catastrophe
- Exogeneous variables like interest rate, regulations, natural catastrophe etc. have significant impact on the combined ratio

Regime switching model – splitting into two

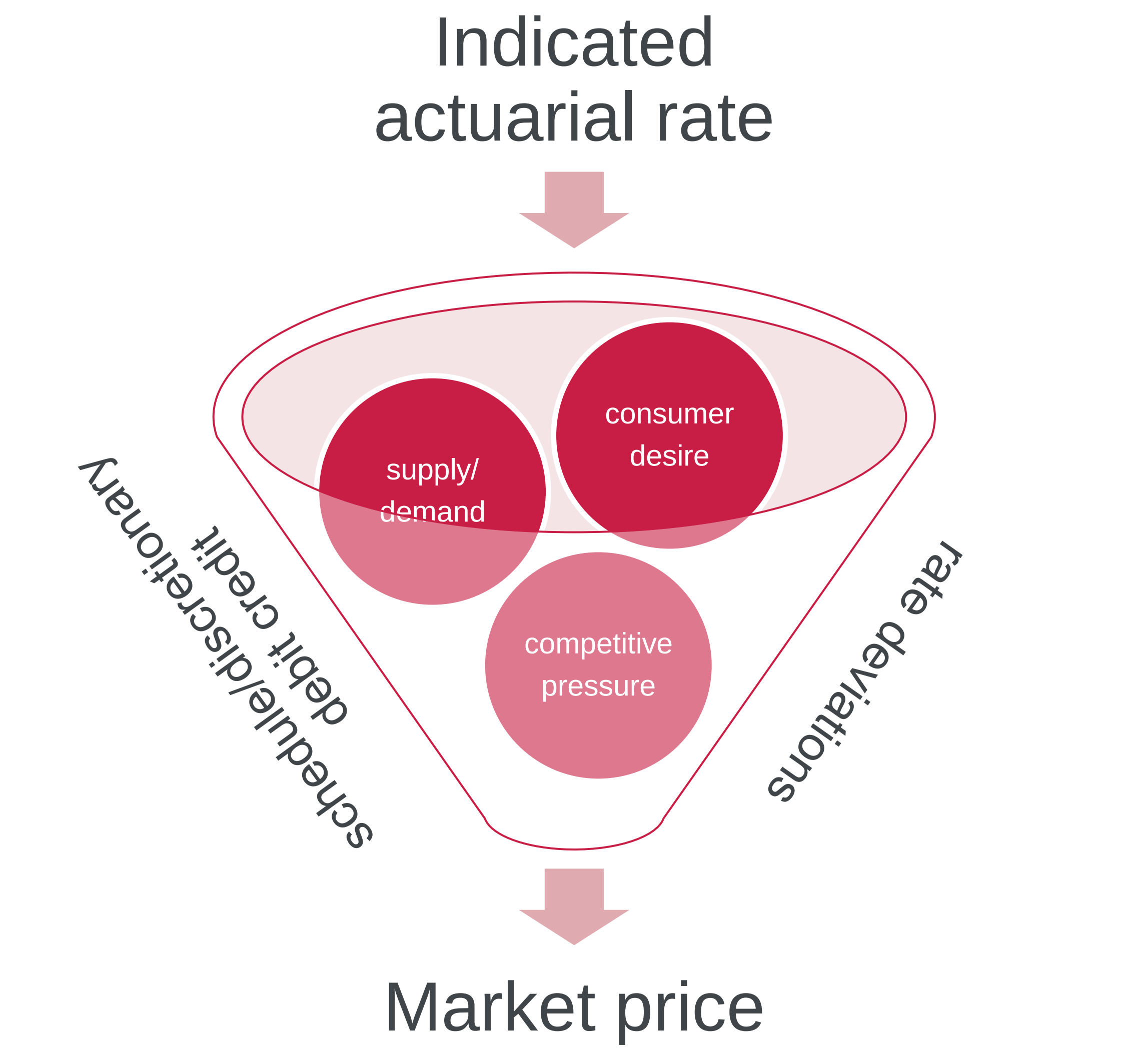




- UP regime : at time t, $Y_t - Y_{t-1} > 0$, i.e., the backward difference positive or zero ; Y_t ~ combined ratio of US commercial marine at time t
- DOWN regime : at time t, $Y_t - Y_{t-1} < 0$, i.e., the backward difference negative ; Y_{t-1} ~ combined ratio of US commercial marine at time t -1
- Each regime is unique in its own right
  - fit them separately and simulate, rather combining
- Non-parametric regression method
  - Locally Estimated Scatterplot Smoothing (LOESS)
- Test for equality of variance,

	UP	DOWN
standard deviation	5.03	2.73
coefficient of variation	5%	3%
Levene test (equivalent to F test with normality assumptions) for equality of variance	p-value = 0.02 < 0.05 (true ratio of variances is not equal to 1 at 5% level of significance)	

Discretionary debit/credit – the wind vane



- Actuaries indicate rates, but the market sets prices
- Underwriting cycle spreads through the industry, raising/lowering the rate
  - adjustment to the indicated rate
  - schedule rating modifications can be as much as 50% in commercial lines
  - discretionary rate deviations from actuarial indications are used in the personal lines
  - more credit in the soft cycle to stay competitive
- Deviations are not quite random
- Closer look at the movement of the deviation may indicate the phase of the cycle
  - Monitoring of loss ratio at different levels of debit/credit should determine the optimal deviation(s)

Chapter IV

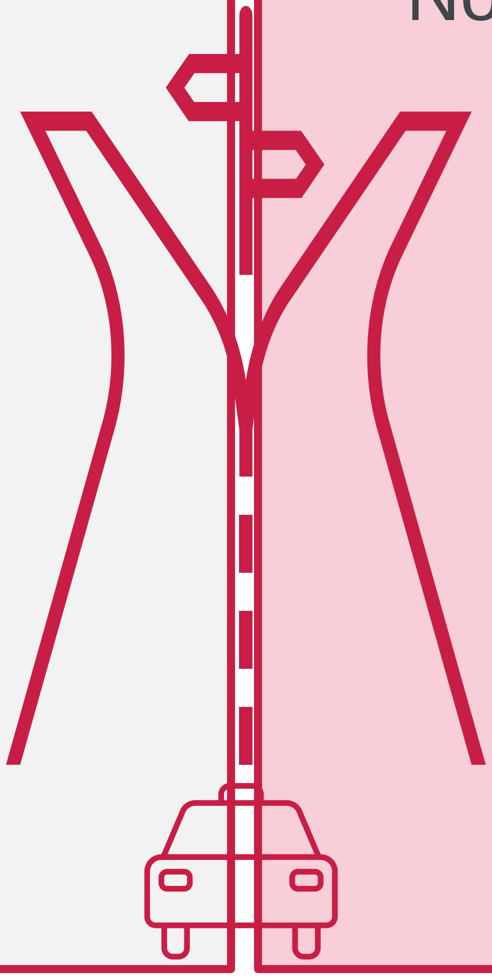
Oh, Art is Art, and Science is Science, and ~~never~~ the twain shall meet!

Photo credit : https://www.reddit.com/

Wild goose chase or a quantum leap? – the dilemma

Let’s do it

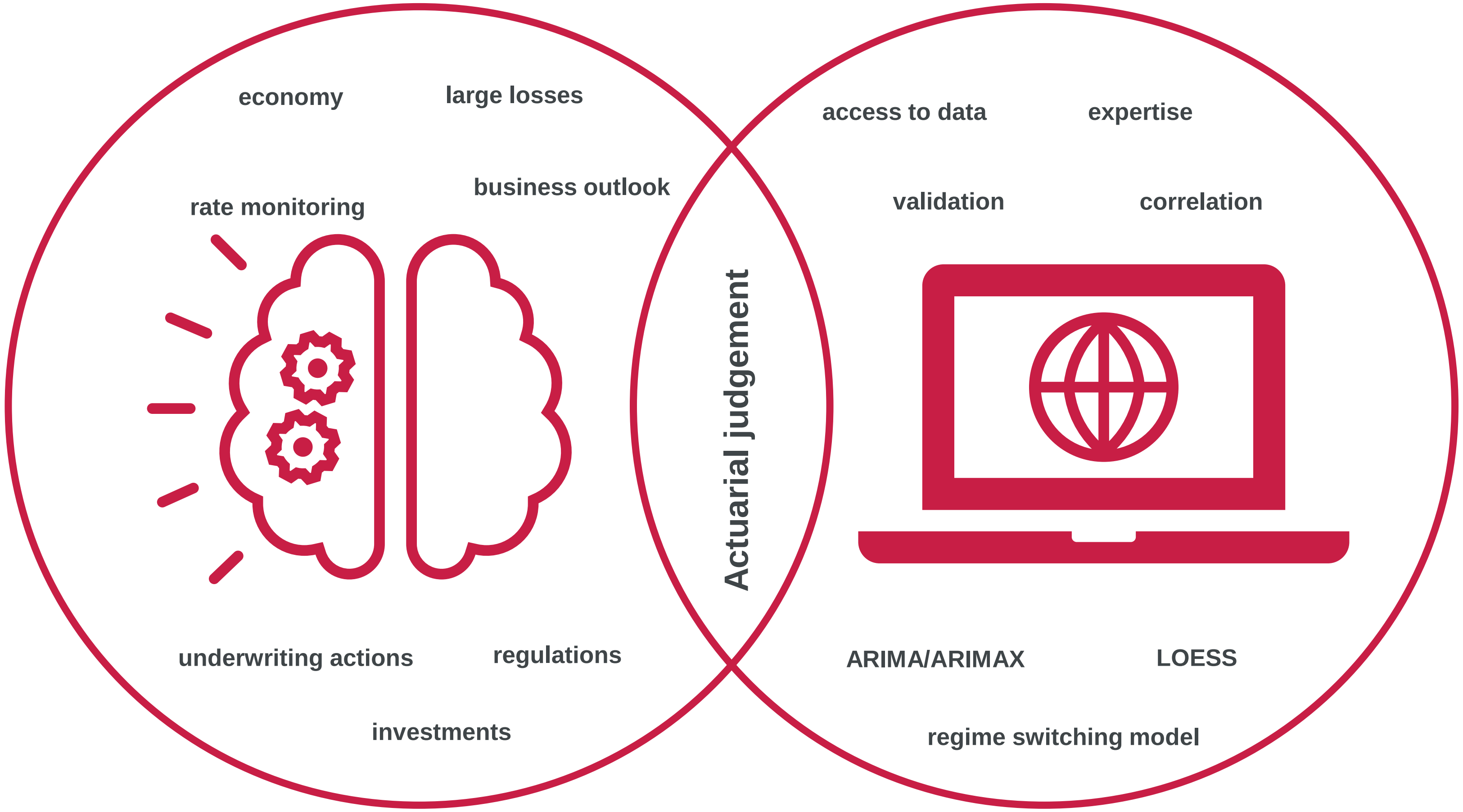
- Lead the market instead of following
  - take competitive advantage of being the early mover
- Cycles are turning more frequently
  - transition from being one global market to many regional markets
- Diversification & portfolio management
  - turn of the cycle can’t be averted but preparedness can have positive impact



Not quiet

- Risk & uncertainty
  - limitations of statistical models in explaining the real word
- External environment
  - the general business environment and their implications are not easy to objectify
- Selection bias
  - training data is not representative of the population being studied

Blending art & science – the best bet



Underwriting judgement
~ " The Art"

Data Science algorithm
~ " The Science"

- Objectifying the UW Cycle keeps us ahead of the curve
- Accuracy & Acceptability are the two big challenges
- Forecasting model is like the engine of a car, whereas the actuarial judgements will always be the steering wheel
- Irrespective of the technological advancement, actuarial judgement is irreplaceable!

Thoughts/Questions?

Acknowledgement

- *Underwriting Cycles and Business Strategies ~ Sholom Feldblum*
  - https://www.casact.org/sites/default/files/database/forum_90spforum_90sp063.pdf
- *U.S. Property-Casualty: Underwriting Cycle Modeling and Risk Benchmarks ~ Shaun S. Wang, PhD, FCAS ; John A. Major, ASA ; Charles H. Pan ; Jessica W.K. Leong, FCAS, FIAA*
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- *Understanding the Current Underwriting Cycle - Difficult Times Extend Hard Market ~ Dr. Thomas Holzheu and James Finucane*
  - https://www.soa.org/sections/reinsurance/reinsurance-newsletter/2021/august/rsn-2021-08-holzheu-finucane/
- *Time Series Analysis: Forecasting and Control ~ George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, and Greta M. Ljung*

Thanks!

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