Confidence Intervals: A Cost Benefit Analysis

PJM FRMSTF
8/4/2021

INTRODUCTION

Why we support the IM framework

- This plugs the last major gap in the already-improved credit policy
- Moving to a volatility-based model reduces failure rate from 8% to 1%
- All confidence intervals contemplated backtest to 1% failure

Stakeholders can now choose between two options with similar benefits but very different costs

Why 95% is better than 97%

- The difference in backtested failure rates between 95% and 97% is only 0.3%[1], and only a fraction of that difference translates to actual losses
- The cost of this marginally higher protection is unjustifiably high: $182M[1] in Q1 2021
- Higher collateral results in less bids, less liquidity, higher costs to hedge, and ultimately higher costs to end-users

1. Slide 4 from https://pjm.com/-/media/committees-groups/task-forces/frmstf/2021/20210716/20210716-item-03-frmstf-phase-ii-bid-and-initial-margining.ashx

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PJM Collateral Rules: Before & After GreenHat

	Before GreenHat	Now/Proposed
Collateral framework	FTR collateral was based upon the difference in bid/purchase price and the FTR's historical performance, allowing GreenHat to select "free" paths whose cost was less than historical congestion	Proposed collateral requirements are based upon volatility, which more closely relates to actual risk
Mark-to-auction (MTA)	No MTA rule, which would have ended GreenHat's mounting losses much sooner, resulting in a much smaller default	MTA currently in place, meaning any shortfall would be limited to price moves over only two auctions
Minimum credit	No minimum $/MWh rule, which would have required GreenHat to post tens of millions to amass their position rather than <$1M	Minimum $/MWh rule currently in place, meaning no free positions and there is a sizable cost to any materially large portfolio
Additional safety measures	No enhanced flexibility for PJM to take further action against GreenHat before it was too late	PJM has substantial flexibility to analyze participant's history, current market activity, and events outside of PJM to limit the participant's access or require more collateral
Failure rate	~8%	~1% (proposed rules)

PJM Collateral Rules: Before & After GreenHat

- Let's keep things in perspective:
  - We have come a long way
  - The policy gaps allowing the GreenHat default have already been plugged
  - The volatility-based collateral model is the last big piece of the puzzle to address other failure mechanisms

- The status quo has a failure rate of 8%
  - Status quo has resulted in few material uncured defaults despite high failure rate
  - GreenHat cannot happen again under already-implemented rules

- The new model has a failure rate of only 1%
  - This is a HUGE improvement, reducing failures by 7/8ths

Confidence Intervals

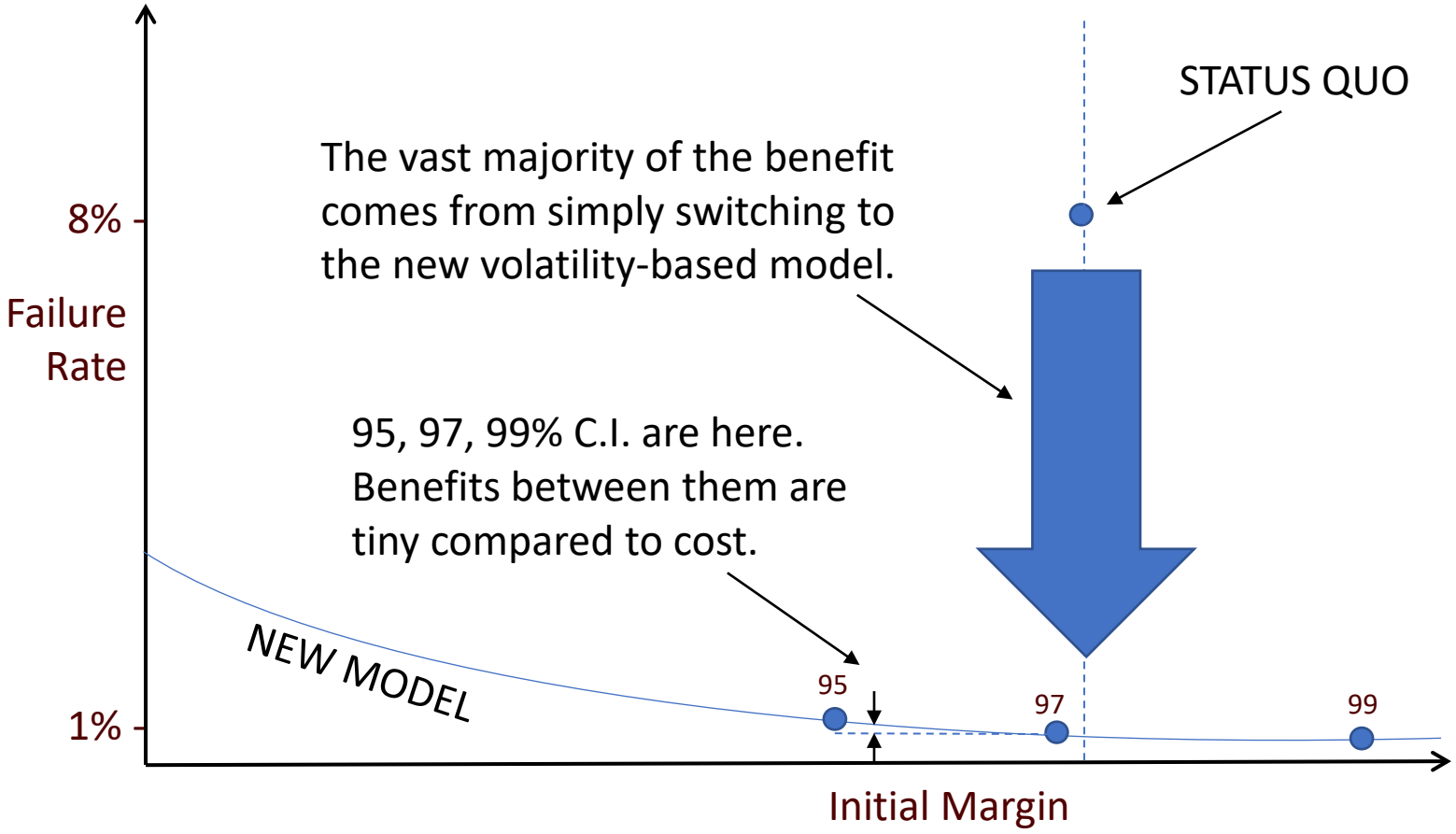
- Confidence intervals (C.I.) describe the likelihood of a desired outcome occurring
  - In this case, a confidence interval of 95% means a participant's Initial Margin should be enough to cover the portfolio's price moves 95% of the time
  - Backtests in PJM show that a C.I. of "95%" actually resulted in collateral being sufficient **98.8%** of the time, compared to 99.1% of the time at a C.I. of 97%

- *All confidence intervals contemplated have a backtested failure rate of 1%*
  - This compares favorably to the status quo's failure rate of 8%
  - Both 97% and 95% represent significant improvements over the status quo and backtested results show very little difference in performance
  - However, the cost of moving from 95% to 97% is far more substantial than the difference in performance

Nominal Confidence Interval	Actual[1]	Cleared Collateral[1]
95%	98.8%	$1,113M
97%	99.1%	$1,295M

1. Slide 4 from https://pjm.com/-/media/committees-groups/task-forces/frmstf/2021/20210716/20210716-item-03-frmstf-phase-ii-bid-and-initial-margining.ashx

Cost vs. Benefit



If we can substantially reduce the total expected shortfall loss to the membership without increasing total cost, that's great! 95% and 97% accomplish that.

Going from 95% to 97% is a marginal benefit with significantly more cost.
(See Appendix A for conservative estimates used in analysis.)

To save **$1** in default cost, the membership must post **$679.** At 5% CoC[1] that costs $34. Imagine choosing a health insurance policy whose only advantage is a copay of $69/visit rather than $70/visit but costs an additional $34 in monthly premiums. We are paying $34 to save $1.

1. CoC = cost of capital. Very likely PJM membership is > 5%

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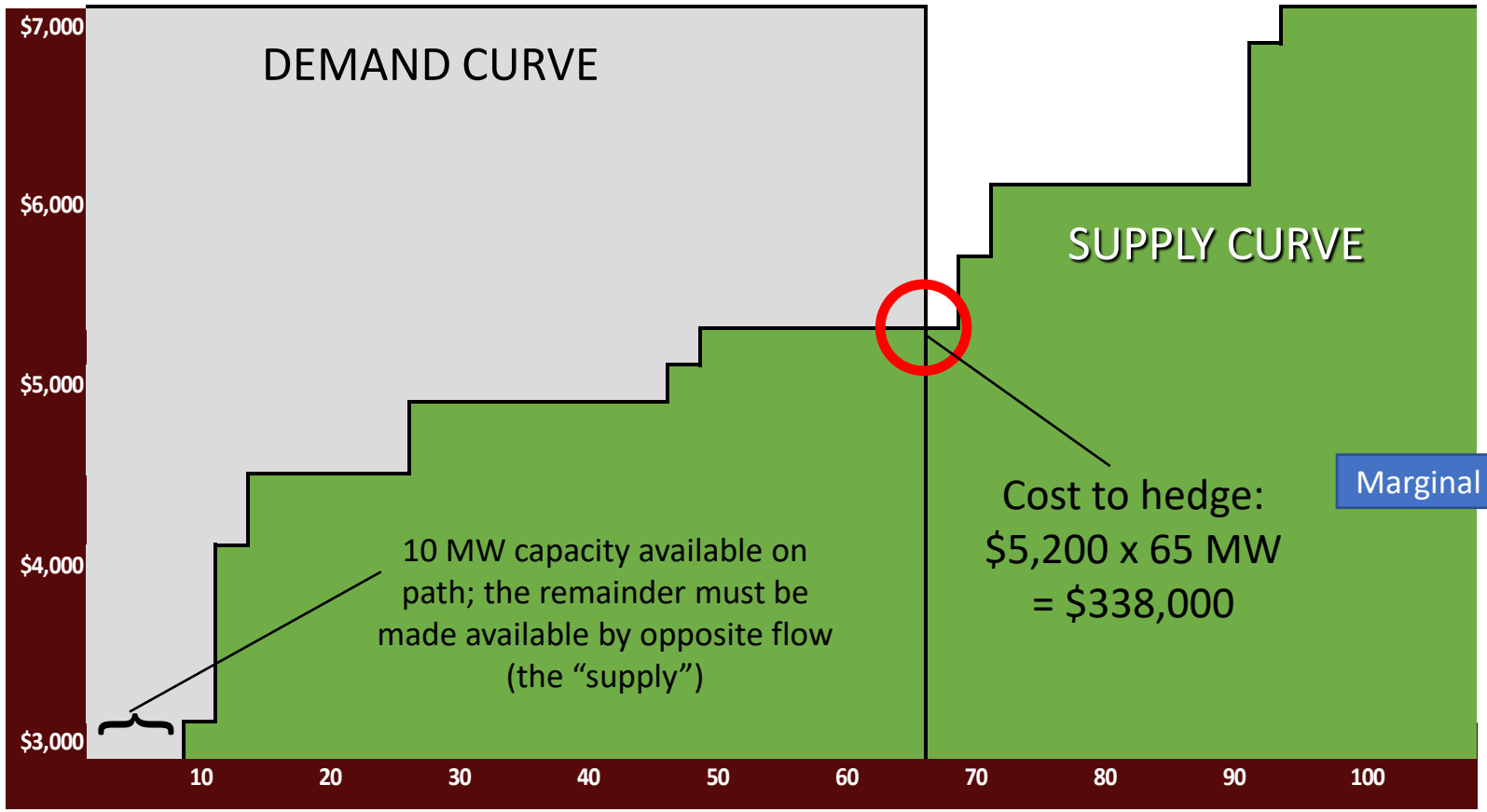
Less Liquidity has a Real Cost: Before

- Hedger *A* needs to hedge 65 MW and is willing to pay up to $7,000/MW for an FTR.
- Participants *B-H* are price sensitive bidders providing liquidity (whether through selling this direction or buying opposite direction).



Bid and offer stack

Trade type	Participant	Bid/Offer ($/MW)	Volume (MW)	Cleared MW
BUY	A	$7,000	65	65
SELL	B	$3,000	3	3
SELL	B	$4,000	2	2
SELL	C	$4,400	10	10
SELL	D	$4,800	20	20
SELL	C	$5,000	5	5
SELL	E	**$5,200**	20	15
SELL	F	$5,600	5	0
SELL	G	$6,000	20	0
SELL	H	$6,800	5	0
SELL	G	$7,000	15	0

Marginal bid

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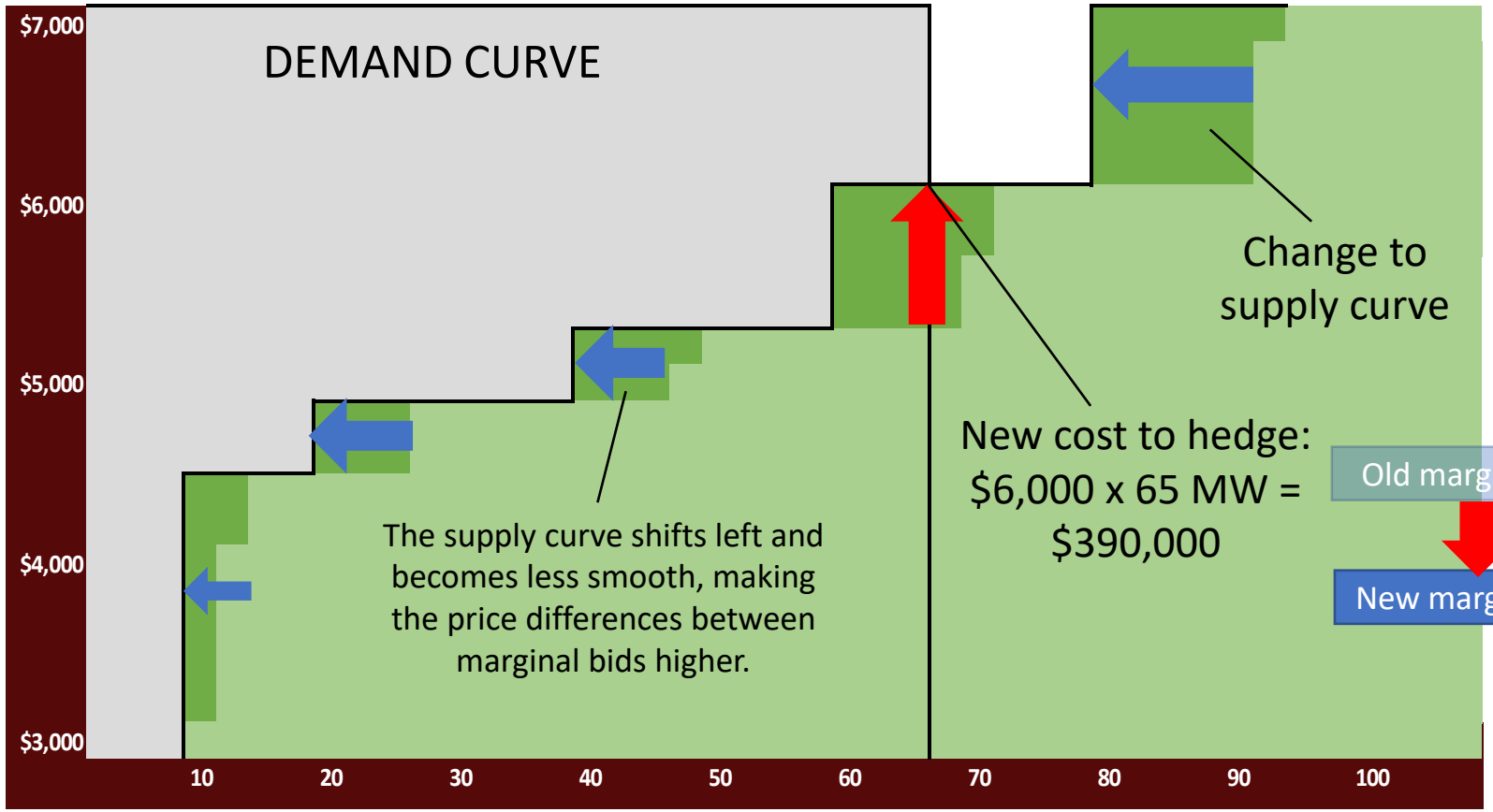
Less Liquidity has a Real Cost: After

- For price-sensitive bidders with finite cash, higher collateral means less bids.
- Once some bids are removed from the supply stack, the curve shifts, making the supply and demand curves ***meet at a higher price:***



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SELL	B	$3,000	3	
SELL	B	$4,000	2	
SELL	C	$4,400	10	10
SELL	D	$4,800	20	20
SELL	C	$5,000	5	
SELL	E	$5,200	20	20
SELL	F	$5,600	5	
SELL	G	**$6,000**	20	5
SELL	H	$6,800	5	
SELL	G	$7,000	15	0

Old marginal bid

New marginal bid

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SUMMARY

- We already have good protections in place
- The volatility-based model is the real win – All confidence intervals contemplated backtest to 1% failure
- No member has expressed support for 97% C.I. in meetings thus far, while many have expressed support for 95%
- PJM has done a great job getting a working volatility-based model in place, but the stakeholders are the only ones with dollars at stake and should therefore choose what level of protection they are willing to pay for
- Higher collateral results in less liquidity and higher costs to end-users
  - Higher costs to hedge by generators and LSEs will be passed on to consumers
- The benefit of going above the "95%" C.I. is marginally less failures—a fraction of which will result in actual losses—but the cost is unjustifiably high

Appendix A:
Cost-Benefit Analysis

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Appendix A: Quantifying Losses due to Default

- Total shortfall = # of failures x average shortfall
  - Assume these occurred over 62 months (a figure used in previous IM backtesting by PJM)
- *Shortfall does not equal default*
  - What is average participant credit available divided by FTR credit requirement? Assume 20% (conservative).
    - E.g., $.5M FTR credit requirement; $.6M in PJM collateral account → availability ratio = 20% above requirement
    - This 20% is higher for price-sensitive bidders, and would be much higher under some proposed bid collaterals
    - Average shortfalls as ratio of IM were 13-54%
      - Any shortfalls <20% would be covered without a collateral call
      - A shortfall of 52% of IM would have only 32% (52-20) of IM as a collateral call
      - % of shortfall uncovered (by existing posted collateral) = 32/52 = 62%
- *Default does not equal stakeholder losses*
  - According to PJM[1], "vast majority" of all defaults have been cured in the past 10 years. Assume 90% (conservative).
- Example calculation (first line of next slide):

$0.88M shortfall per year x 62% uncovered shortfall ratio x (1 – 90%) uncured default rate **= $54k losses/yr**

1. Slide 6 from https://pjm.com/-/media/committees-groups/task-forces/frmstf/2020/20201015/20201015-item-06a-minimum-capitalization.ashx

APPENDIX A: QUANTIFYING LOSSES

	A	B	C	A x B x C

99

IM Range (million USD)	Shortfall (% of IM)	Average Shortfall ($ in MM)	Max Shortfall ($ in MM)	Failure Rate (%)	Count of Observations	Total Shortfall	Shortfall per yr	% Shortfall uncovered	Uncured rate	Default per yr
0-1	52	0.06	0.79	0.48%	76	$4.56M	$0.88M	62%	10%	$54k
1-3	43	0.76	2.32	0.06%	10	$7.60M	$1.47M	53%	10%	$78k
3-10	13	0.63	1.48	0.06%	9	$5.67M	$1.10M	0%	10%	$0
10 and above	37	7.19	22.29	0.04%	7	$50.33M	$9.74M	46%	10%	$448k

97

IM Range (million USD)	Shortfall (% of IM)	Average Shortfall ($ in MM)	Max Shortfall ($ in MM)	Failure Rate (%)	Count of Observations	Total Shortfall	Shortfall per yr	% Shortfall uncovered	Uncured rate	Default per yr
0-1	53	0.08	0.87	0.64%	109	$8.72M	$1.69M	62%	10%	$105k
1-3	49	0.80	2.62	0.08%	13	$10.40M	$2.01M	59%	10%	$119k
3-10	18	1.07	7.37	0.12%	20	$21.40M	$4.14M	0%	10%	$0
10 and above	32	5.63	25.41	0.06%	11	$61.93M	$11.99M	38%	10%	$449k

95

IM Range (million USD)	Shortfall (% of IM)	Average Shortfall ($ in MM)	Max Shortfall ($ in MM)	Failure Rate (%)	Count of Observations	Total Shortfall	Shortfall per yr	% Shortfall uncovered	Uncured rate	Default per yr
0-1	54	0.08	0.89	0.81%	138	$11.04M	$2.14M	63%	10%	$134k
1-3	32	0.55	2.74	0.17%	29	$15.95M	$3.09M	38%	10%	$116k
3-10	19	1.07	8.10	0.15%	26	$27.82M	$5.38M	0%	10%	$0
10 and above	37	5.98	26.71	0.08%	13	$77.74M	$15.05M	46%	10%	$691k

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Appendix A: Weigh the Cost / Benefit

	99% Conf. Int.	97% Conf. Int.	95% Conf. Int.	Status Quo
Expected default loss per year	$581,000	$674,000	$942,000	?
Expected annual default per member	$581	$674	$942	?
Collateral required	(Z) $1,698,000,000	(Y) $1,295,000,000	(X) $1,113,000,000	(A) $1,334,000,000
Total cost to members (5% CoC)	Cost of capital (CoC) * Z = $84,900,000	CoC * Y = $64,750,000	CoC * X = $55,650,000	CoC * A = $66,700,000
Marginal benefit to cost ratio	$93,000 / [(Z-Y)*CoC] = 0.5%	$268,000 / [(Y-X)*CoC] = 3.0%	? / [(X-A)*CoC] = ?	

$674k - $581k

$942k - $674k

Going from 97% to 99%, every $1 extra spent posting collateral (or every $20 posted) prevents only $0.005 in loss

Going from 95% to 97%, every $1 extra spent posting collateral (or every $20 posted) prevents only $0.03 in loss. Or, every $679 posted prevents $1 in loss.

- The membership posting an extra $182M going from 95% C.I. to 97% C.I. (which costs an additional $9.1M based on 5% cost of capital) saves only $268,000
- Spending $9.1M to save $268k does not make sense

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