ACLI Equity Calibration Proposal

October 2, 2024

Equity Model

- Prior to the 2024 GOES field test (FT2), ACLI identified that equity calibrations were meaningfully more severe for the tail distribution in the longer time horizon than the Academy's criteria

- Specifically, Gross Wealth Factor (GWF) targets at higher durations (20+ years) in the right (low return) tails were lower than targets.

- It is unclear how certain parameters were set in the calibration

Equity Model

- ACLI proposed an alternative approach to address this concern.

- In March 2024 discussions, Conning raised concerns regarding the jump process in other equity indices in the ACLI approach.

- Given turnaround time, ACLI was not able to address these issues before FT2 and agreed to revisit the issue after the field test.

- Subsequently, we have updated ACLI calibration to address the issues regarding the correlations and jump processes of the other indices relative to the Large Cap concern identified by Conning

Equity Model

- ACLI proposal calibrated to the history by using Maximum Likelihood Estimation (MLE) with additional adjustments to make sure appropriate relationship across model indices. This approach aligns with the adopted AAA Equity Criteria based on average GWFs across reference models.

- Under this approach, modeled returns reasonably reflect the historical market distribution and key relationships across indices, including return volatility and Sharpe ratio.

- Modeled ACLI results are based on externally implemented GEMS proxy model based on publicly disclosed model details. Proposed parameters must be run directly through GEMS software to confirm intended outcomes and for possible minor refinements.

Appendix

Calibration and Parameters

	Large	Mid	Small	Aggressive
mu0	0.0723	0.0408	0.0556	0.1233
mu1	0.5744	2.0910	1.5311	-0.2500
alpha	0.0196	0.0307	0.0308	0.0191
beta	0.9519	1.1310	0.9408	0.4800
sigma	0.1254	0.1409	0.1409	0.1587
mu_jump	-0.1500	-0.2184	-0.2355	-0.1990
sigma_jump	0.0584	0.0476	0.0480	0.0678
lambda_jump	4.9442	4.6774	3.8906	3.6347
correlation	-0.4563	-0.6661	-0.6275	-0.3105
initial vol	0.1435	0.1648	0.1809	0.1997
theta	0.0206	0.0272	0.0327	0.0399
Avg. Jump Freq.	0.1019	0.1270	0.1273	0.1449
% Jump Variance	11.4%	18.9%	18.3%	13.8%
MLE Sum LL	914	838	788	756
MLE Avg. LL	1.8	1.7	1.6	1.5

Equity return assumed to be independent of short rate, i.e. follows constant mean return, implying the short rate as part of total return is effectively set to zero.

Model parameters calibrated to monthly historical data using generalized MLE:
- Large Cap: S&P total return index from 8/1978 to 12/2020, based on data provided by Link Richardson from a combination of sources
- Mid Cap: Willshire Mid Cap from 8/1978 to 12/2020 , sourced from FRED
- Small Cap: Willshire Small Cap from 8/1978 to 12/2020 , sourced from FRED
- Aggressive: NASDAQ Composite from 3/1971 to 12/2020 , sourced from FRED

Adjustments / Targeting
- MLE calibration included a 12% cap on jump frequency, to better align with historical correlations. Note that this frequency was subject to variance adjustment below.

- Large Cap drift coefficient, mu0, was adjusted by -.0383 to align with 8.75% average target proposed by NAIC in the original AIRG specification

- Mid, Small, and Aggressive alpha (variance target) parameter was adjusted to align with historical relationship to Large Cap returns

- Mid, Small and Aggressive, had mu0 adjusted to align with the Sharpe Ratio of 28.1% implied in the Large Cap scenarios, and assuming a risk-free rate of 3%.

GWF Comparison vs. AAA Criteria: ACLI and FT2 Baseline

ACLI Large Cap

	1 Yr	5 Yr	10 Yr	20 Yr	30 Yr	50 Yr
Min	0.49	0.17	0.16	0.19	0.21	0.54
0.5%	0.67	0.51	0.48	0.62	0.89	2.13
1.0%	0.70	0.57	0.58	0.76	1.15	2.75
5.0%	0.82	0.78	0.90	1.36	2.23	6.17
10.0%	0.88	0.92	1.11	1.82	3.05	9.48
25.0%	0.98	1.17	1.54	2.81	5.11	18.81
50.0%	1.09	1.47	2.14	4.44	9.20	39.45
75.0%	1.19	1.82	2.89	6.92	15.79	79.76
90.0%	1.29	2.16	3.70	9.99	25.22	148.83
95.0%	1.34	2.40	4.33	12.50	33.40	209.78
99.0%	1.47	2.91	5.62	19.04	52.86	415.11
99.5%	1.51	3.12	6.26	22.26	66.31	512.63
Max	1.83	4.70	10.85	43.13	168.19	1,514.65

AAA Criteria (Avg. GWF)

	1 Yr	5 Yr	10 Yr	20 Yr	30 Yr	50 Yr
Min	0.46	0.25	0.22	0.25	0.29	0.46
0.5%						
1.0%	0.70	0.58	0.60	0.79	1.15	2.82
5.0%	0.82	0.80	0.91	1.36	2.20	6.38
10.0%	0.88	0.93	1.12	1.81	3.08	9.78
25.0%	0.99	1.18	1.54	2.81	5.26	19.23
50.0%	1.09	1.48	2.15	4.47	9.23	39.98
75.0%	1.19	1.82	2.89	6.93	15.88	80.22
90.0%	1.28	2.15	3.71	10.09	25.20	147.92
95.0%	1.34	2.37	4.30	12.33	33.19	210.72
99.0%	1.45	2.82	5.64	18.18	53.74	397.23
99.5%						
Max	1.76	4.20	8.98	42.03	140.72	1,676.94

ACLI / AAA Criteria

	1 Yr	5 Yr	10 Yr	20 Yr	30 Yr	50 Yr
Min	1.07	0.70	0.72	0.73	0.72	1.19
0.5%						
1.0%	1.00	0.99	0.97	0.96	1.00	0.97
5.0%	1.00	0.99	0.98	1.00	1.01	0.97
10.0%	1.00	1.00	0.99	1.01	0.99	0.97
25.0%	1.00	1.00	1.00	1.00	0.97	0.98
50.0%	1.00	1.00	1.00	0.99	1.00	0.99
75.0%	1.00	1.00	1.00	1.00	0.99	0.99
90.0%	1.00	1.00	1.00	0.99	1.00	1.01
95.0%	1.00	1.01	1.00	1.01	1.01	1.00
99.0%	1.01	1.03	1.00	1.05	0.98	1.05
99.5%						
Max	1.04	1.12	1.21	1.03	1.20	0.90

GEMS FT2 Large Cap

	1 Yr	5 Yr	10 Yr	20 Yr	30 Yr	50 Yr
Min	0.49	0.21	0.14	0.08	0.17	0.26
0.5%	0.66	0.47	0.42	0.50	0.69	1.45
1.0%	0.70	0.55	0.53	0.63	0.93	2.07
5.0%	0.82	0.79	0.88	1.29	2.02	5.50
10.0%	0.88	0.92	1.11	1.74	2.93	8.83
25.0%	0.99	1.18	1.55	2.80	5.17	18.47
50.0%	1.10	1.49	2.17	4.48	9.28	39.71
75.0%	1.20	1.83	2.92	6.96	15.89	80.47
90.0%	1.30	2.17	3.76	9.97	25.08	148.39
95.0%	1.36	2.39	4.38	12.31	32.53	207.89
99.0%	1.47	2.83	5.69	17.54	50.60	413.34
99.5%	1.52	2.99	6.39	19.81	59.40	504.06
Max	1.82	4.29	9.32	38.28	120.07	2,292.47

AAA Criteria (Avg. GWF)

	1 Yr	5 Yr	10 Yr	20 Yr	30 Yr	50 Yr
Min	0.46	0.25	0.22	0.25	0.29	0.46
0.5%						
1.0%	0.70	0.58	0.60	0.79	1.15	2.82
5.0%	0.82	0.80	0.91	1.36	2.20	6.38
10.0%	0.88	0.93	1.12	1.81	3.08	9.78
25.0%	0.99	1.18	1.54	2.81	5.26	19.23
50.0%	1.09	1.48	2.15	4.47	9.23	39.98
75.0%	1.19	1.82	2.89	6.93	15.88	80.22
90.0%	1.28	2.15	3.71	10.09	25.20	147.92
95.0%	1.34	2.37	4.30	12.33	33.19	210.72
99.0%	1.45	2.82	5.64	18.18	53.74	397.23
99.5%						
Max	1.76	4.20	8.98	42.03	140.72	1,676.94

GEMS FT2 / AAA Criteria

	1 Yr	5 Yr	10 Yr	20 Yr	30 Yr	50 Yr
Min	1.08	0.87	0.64	0.29	0.57	0.57
0.5%						
1.0%	1.00	0.95	0.88	0.79	0.81	0.73
5.0%	1.00	1.00	0.96	0.95	0.92	0.86
10.0%	1.00	0.99	0.99	0.96	0.95	0.90
25.0%	1.00	1.01	1.01	1.00	0.98	0.96
50.0%	1.01	1.01	1.01	1.00	1.01	0.99
75.0%	1.01	1.01	1.01	1.00	1.00	1.00
90.0%	1.01	1.01	1.01	0.99	1.00	1.00
95.0%	1.01	1.01	1.02	1.00	0.98	0.99
99.0%	1.01	1.00	1.01	0.96	0.94	1.04
99.5%						
Max	1.03	1.02	1.04	0.91	0.85	1.37