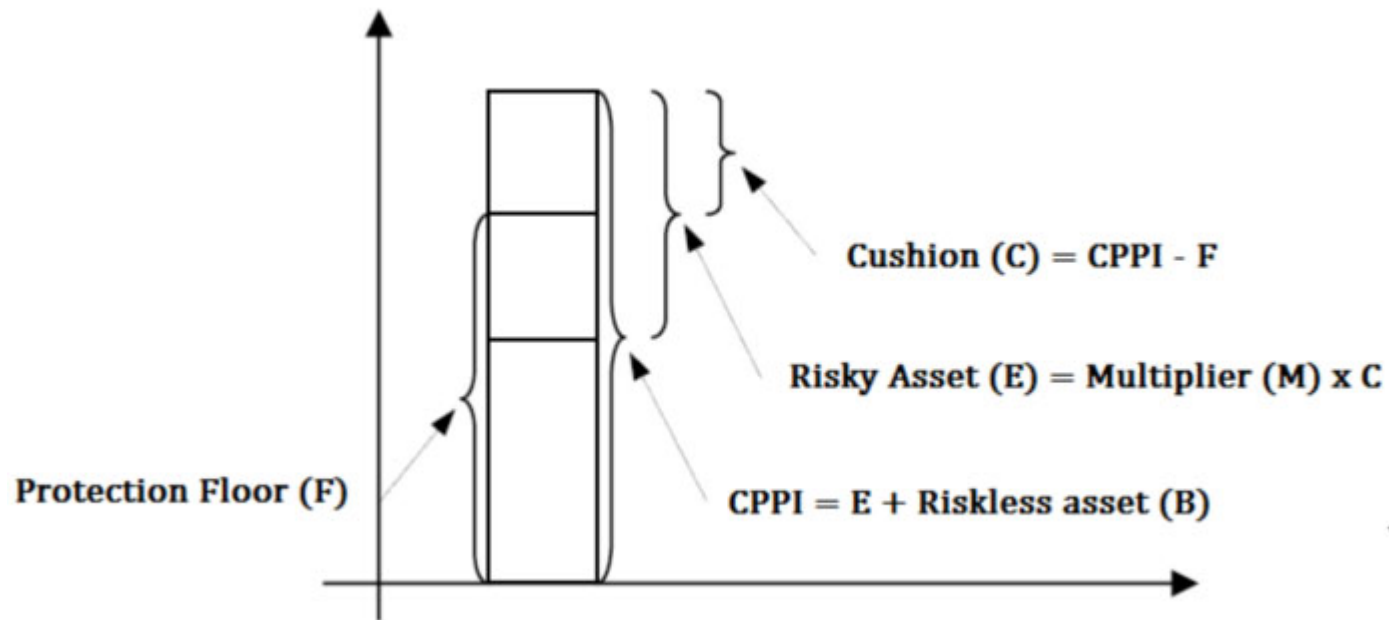# Portfolio insurance

- Downside risk protection algorithm
- Four methods for portfolio insurance
    1. Trading stocks and options
    2. Using option pricing models
    3. CPPI
    4. TIPP
- CPPI (Constant Proportion Portfolio Insurance)
    – Black and Jones (1987)
- TIPP (Time-Invariant Protection Portfolio)
    – Estep and Kritzman (1988)

CPPI

Protection Floor (F)

Cushion (C) = CPPI - F

Risky Asset (E) = Multiplier (M) x C

CPPI = E + Riskless asset (B)

(1) Total Investment Amount (Asset Value, AV=CPPI=100%)
(2) Protection Floor (F = 85%)
(3) Cushion = CPPI – F = 15%
(4) Multiplier (M = 4)
(5) Risky Asset (E = M * C = 60%)
(6) Safe Asset (B = 100% - 60% = 40%)

CPPI algorithm

1. Total Investment = $100
2. Floor = 85%
3. Multiplier M = 4 (3 ~ 8)

Repeat

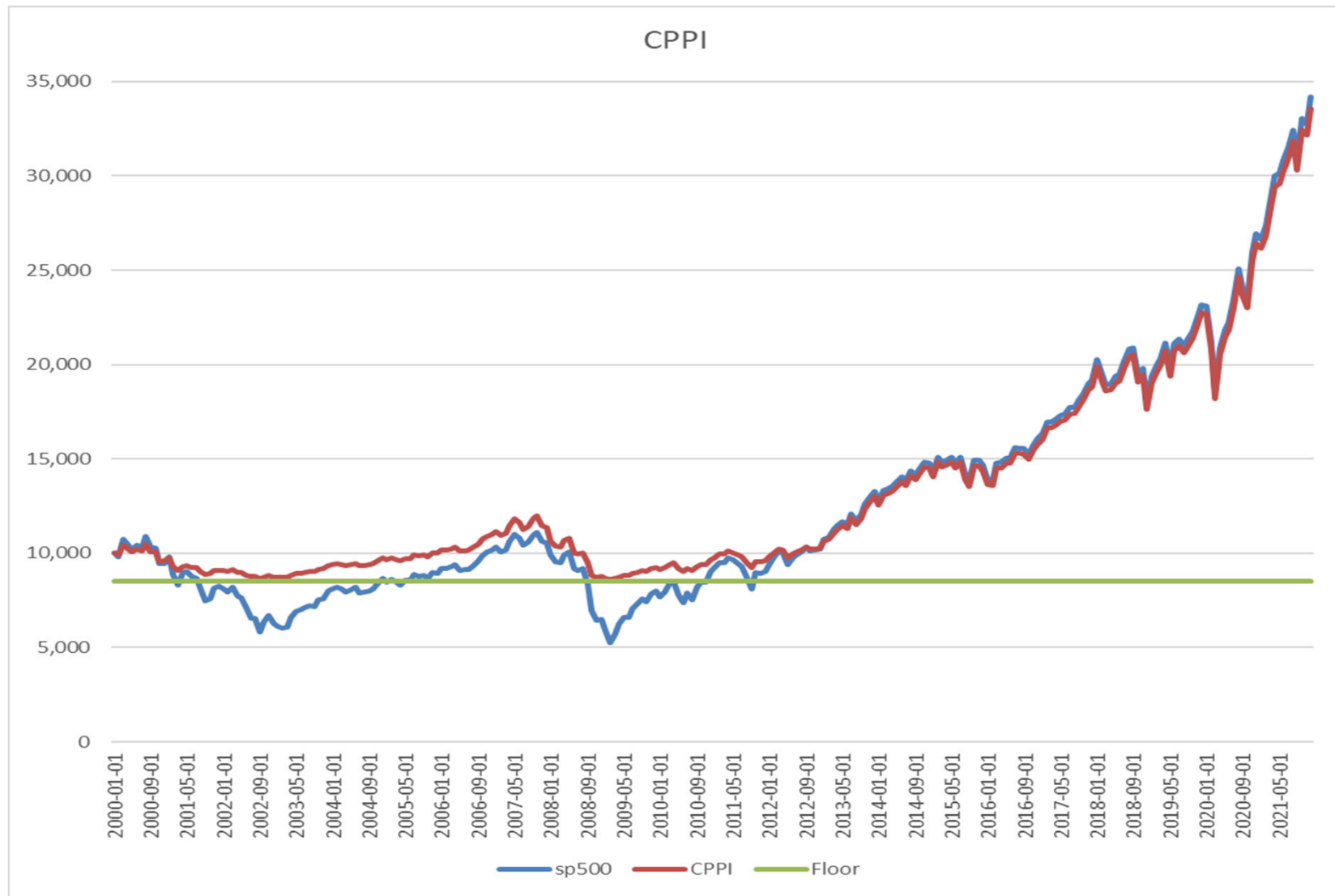4. Cushion (C = CPPI – F = 15$)
5. Risky Asset (E = C * M = 15 * 4 = 60$)
6. Safe Asset (B = AV – E = 40$)
7. CPPI = E*(1 + return) + B*(1 + safe_return)

CPPI 투자 분석

protection floor(F)	85%	8,500							
multiplier (M)	4								
초기투자금액	10,000								
CMA 금리	2%								
			주식 100% 투자	CPPI					
	sp500	수익율		기초금액	Floor	cushion	주식투자금액	CMA 투자금액	주식투자비중
2000-01-31	1394.46		10,000	10,000	8,500	1,500	6,000	4,000	60%
2000-02-29	1366.42	-2.01%	9,799	9,886	8,500	1,386	5,544	4,342	56%
2000-03-31	1498.58	9.67%	10,747	10,429	8,500	1,929	7,718	2,712	74%
2000-04-28	1452.43	-3.08%	10,416	10,196	8,500	1,696	6,785	3,411	67%
2000-05-31	1420.6	-2.19%	10,187	10,053	8,500	1,553	6,213	3,840	62%
2000-06-30	1454.6	2.39%	10,431	10,208	8,500	1,708	6,834	3,375	67%
2000-07-31	1430.83	-1.63%	10,261	10,102	8,500	1,602	6,409	3,693	63%
2000-08-31	1517.68	6.07%	10,884	10,498	8,500	1,998	7,990	2,507	76%
2000-09-29	1436.51	-5.35%	10,302	10,074	8,500	1,574	6,298	3,777	63%
2000-10-31	1429.4	-0.49%	10,251	10,050	8,500	1,550	6,198	3,851	62%
2000-11-30	1314.95	-8.01%	9,430	9,560	8,500	1,060	4,239	5,321	44%
2000-12-29	1320.28	0.41%	9,468	9,586	8,500	1,086	4,343	5,243	45%
2001-01-31	1366.01	3.46%	9,796	9,745	8,500	1,245	4,980	4,765	51%
2001-02-28	1239.94	-9.23%	8,892	9,293	8,500	793	3,173	6,120	34%
2001-03-30	1160.33	-6.42%	8,321	9,100	8,500	600	2,399	6,701	26%
2001-04-30	1249.46	7.68%	8,960	9,295	8,500	795	3,181	6,114	34%

CPPI 결과

CPPI 주식투자비중

주식투자비중

TIPP algorithm

1. Total Investment = $100
2. Floor = 85%
3. Multiplier M = 4 (3 ~ 8)

Repeat

4. Cushion (C = TIPP – F = 15$)
5. Risky Asset (E = C * M = 15 * 4 = 60$)
6. Safe Asset (B = AV – E = 40$)
7. TIPP = E*(1 + return) + B*(1 + safe_return)
8. Floor = max(TIPP*85%, 전기의 Floor)

TIPP 투자 분석

			주식 100% 투자	TIPP					
protection floor(F)	85%	8,500							
multiplier (M)	4								
초기투자금액	10,000								
CMA 금리	2%								
	sp500	수익율		기초금액	Floor	cushion	주식투자금액	CMA 투자금액	주식투자비중
2000-01-31	1394.46		10,000	10,000	8,500	1,500	6,000	4,000	60%
2000-02-29	1366.42	-2.01%	9,799	9,886	8,500	1,386	5,544	4,342	56%
2000-03-31	1498.58	9.67%	10,747	10,429	8,865	1,564	6,258	4,172	60%
2000-04-28	1452.43	-3.08%	10,416	10,244	8,865	1,379	5,515	4,729	54%
2000-05-31	1420.6	-2.19%	10,187	10,131	8,865	1,266	5,063	5,068	50%
2000-06-30	1454.6	2.39%	10,431	10,260	8,865	1,395	5,581	4,679	54%
2000-07-31	1430.83	-1.63%	10,261	10,177	8,865	1,312	5,248	4,929	52%
2000-08-31	1517.68	6.07%	10,884	10,504	8,928	1,576	6,302	4,201	60%
2000-09-29	1436.51	-5.35%	10,302	10,174	8,928	1,245	4,982	5,192	49%
2000-10-31	1429.4	-0.49%	10,251	10,158	8,928	1,229	4,918	5,240	48%
2000-11-30	1314.95	-8.01%	9,430	9,773	8,928	844	3,378	6,395	35%
2000-12-29	1320.28	0.41%	9,468	9,797	8,928	869	3,475	6,322	35%
2001-01-31	1366.01	3.46%	9,796	9,928	8,928	1,000	3,999	5,929	40%
2001-02-28	1239.94	-9.23%	8,892	9,569	8,928	641	2,562	7,007	27%
2001-03-30	1160.33	-6.42%	8,321	9,416	8,928	488	1,951	7,465	21%
2001-04-30	1249.46	7.68%	8,960	9,578	8,928	650	2,600	6,978	27%

TIPP 결과
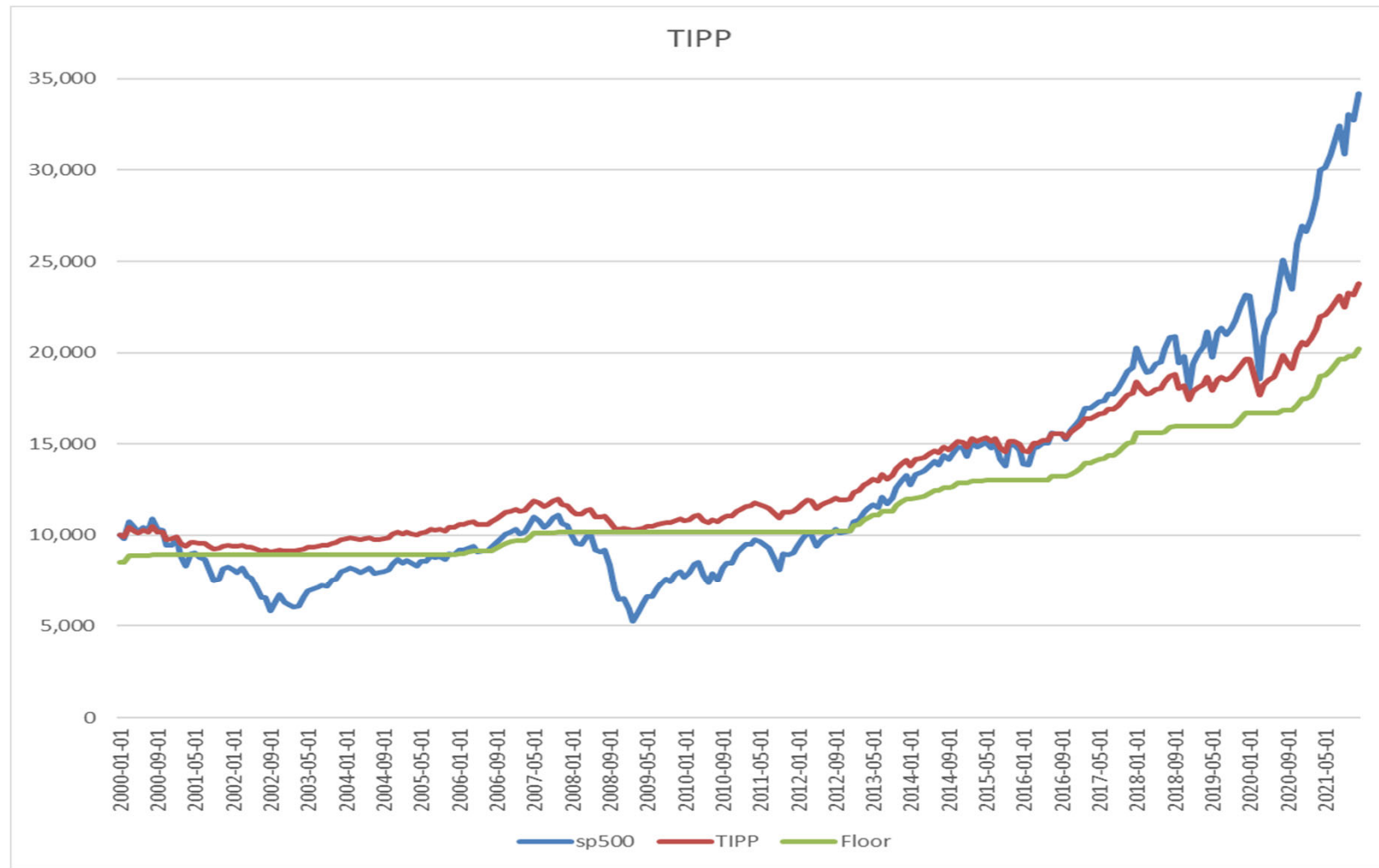
TIPP 주식투자비중

주식투자비중

CPPI (python)

	date	sp500	ret	stock100	CPPI	floor	cushion	stock	CMA	ratio
0	2000-01-31	1394.46	NaN	10000.000000	10000.000000	8500.0	1500.000000	6000.000000	4000.000000	0.600000
1	2000-02-29	1366.42	-0.020108	9798.918578	9886.017813	8500.0	1386.017813	5544.071253	4341.946560	0.560799
2	2000-03-31	1498.58	0.096720	10746.668961	10429.476385	8500.0	1929.476385	7717.905539	2711.570846	0.740009
3	2000-04-28	1452.43	-0.030796	10415.716478	10196.316439	8500.0	1696.316439	6785.265758	3411.050682	0.665462
4	2000-05-31	1420.60	-0.021915	10187.456076	10053.302441	8500.0	1553.302441	6213.209764	3840.092677	0.618027
...	...	...	...	...	...	...	...	...	...	...
259	2021-08-31	4522.68	0.028990	32433.199948	31834.844961	8500.0	23334.844961	31834.844961	0.000000	1.000000
260	2021-09-30	4307.54	-0.047569	30890.380506	30320.488751	8500.0	21820.488751	30320.488751	0.000000	1.000000
261	2021-10-29	4605.38	0.069144	33026.261062	32416.964783	8500.0	23916.964783	32416.964783	0.000000	1.000000
262	2021-11-30	4567.00	-0.008334	32751.029072	32146.810505	8500.0	23646.810505	32146.810505	0.000000	1.000000
263	2021-12-31	4766.18	0.043613	34179.395608	33548.825333	8500.0	25048.825333	33548.825333	0.000000	1.000000

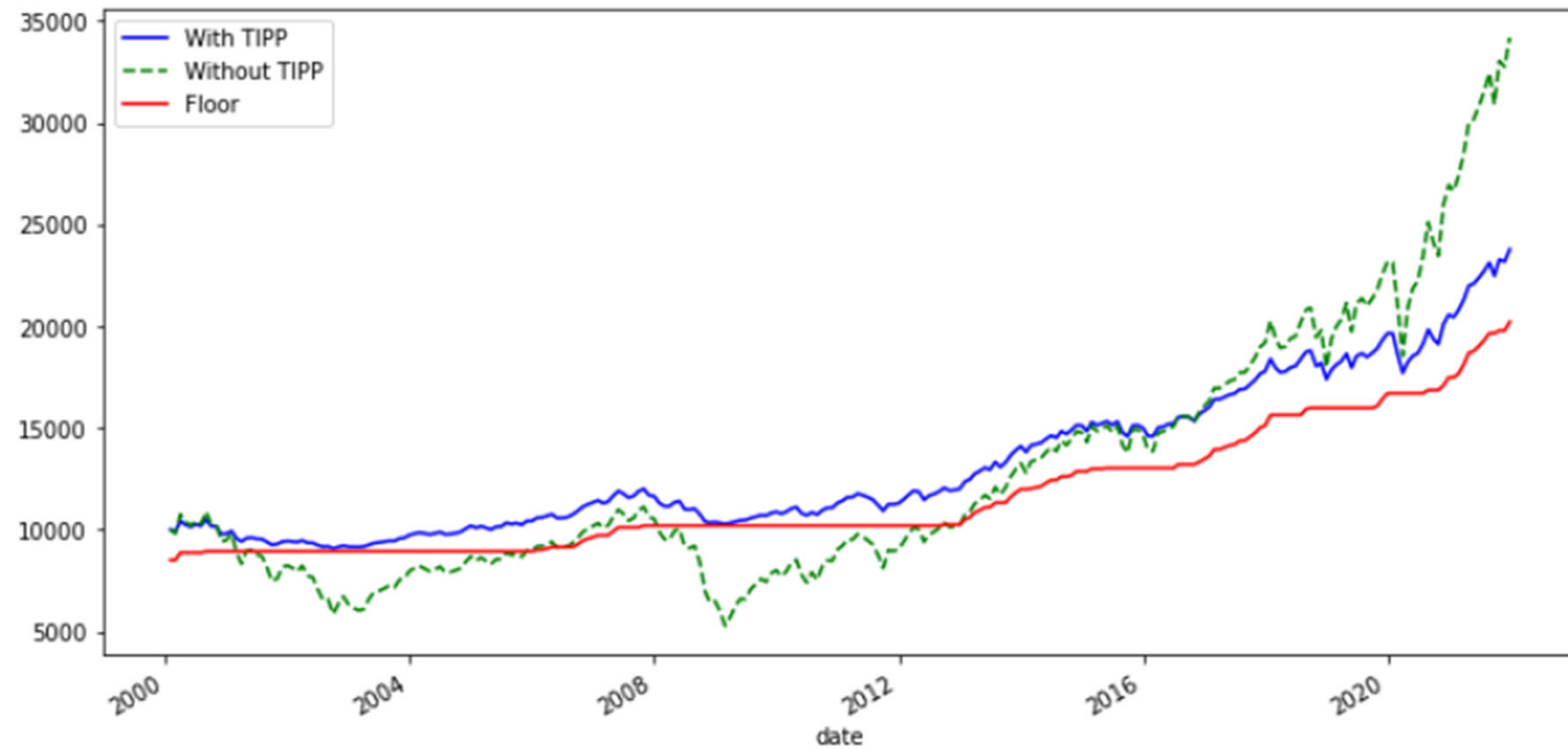# CPPI figure (python)
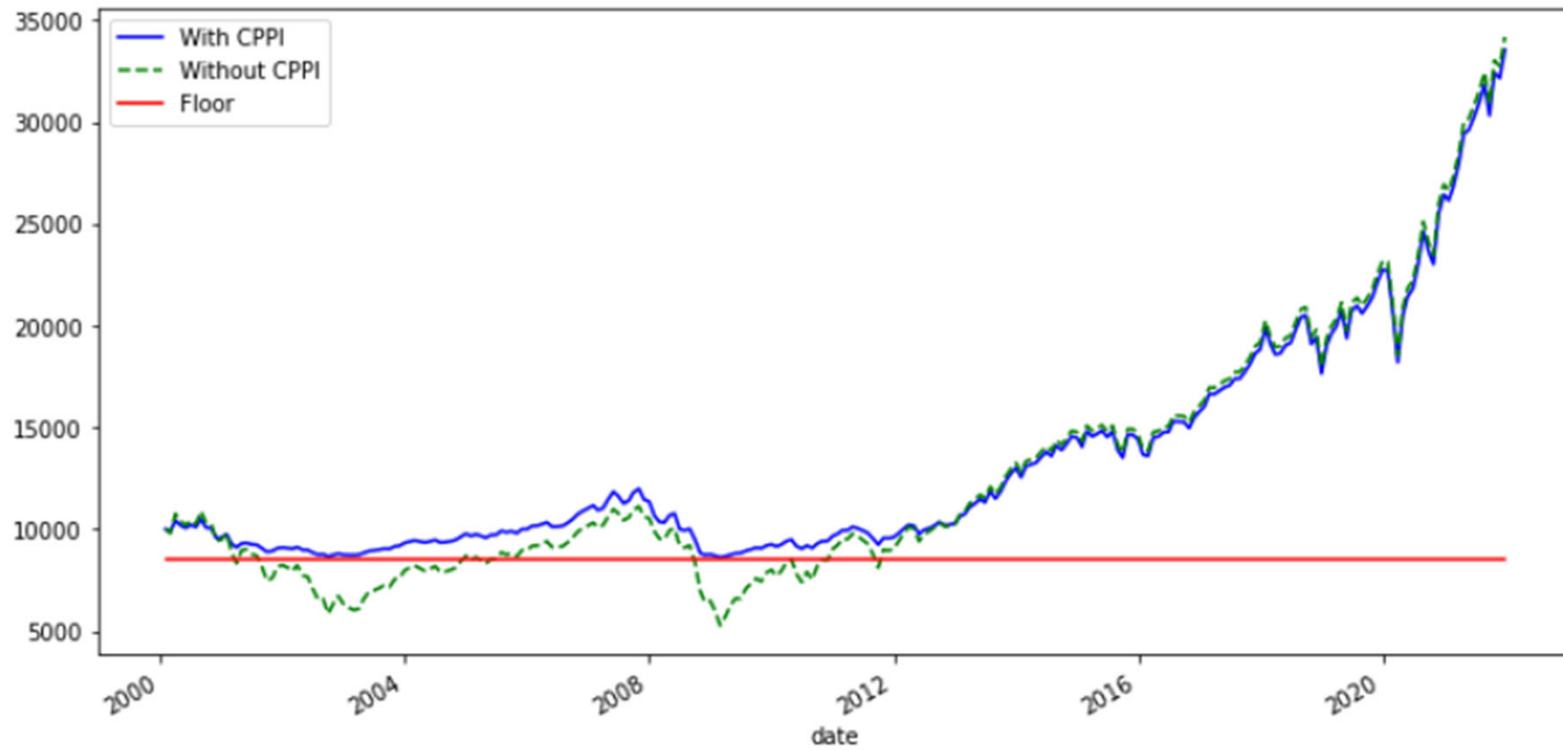
Stock weight (python)
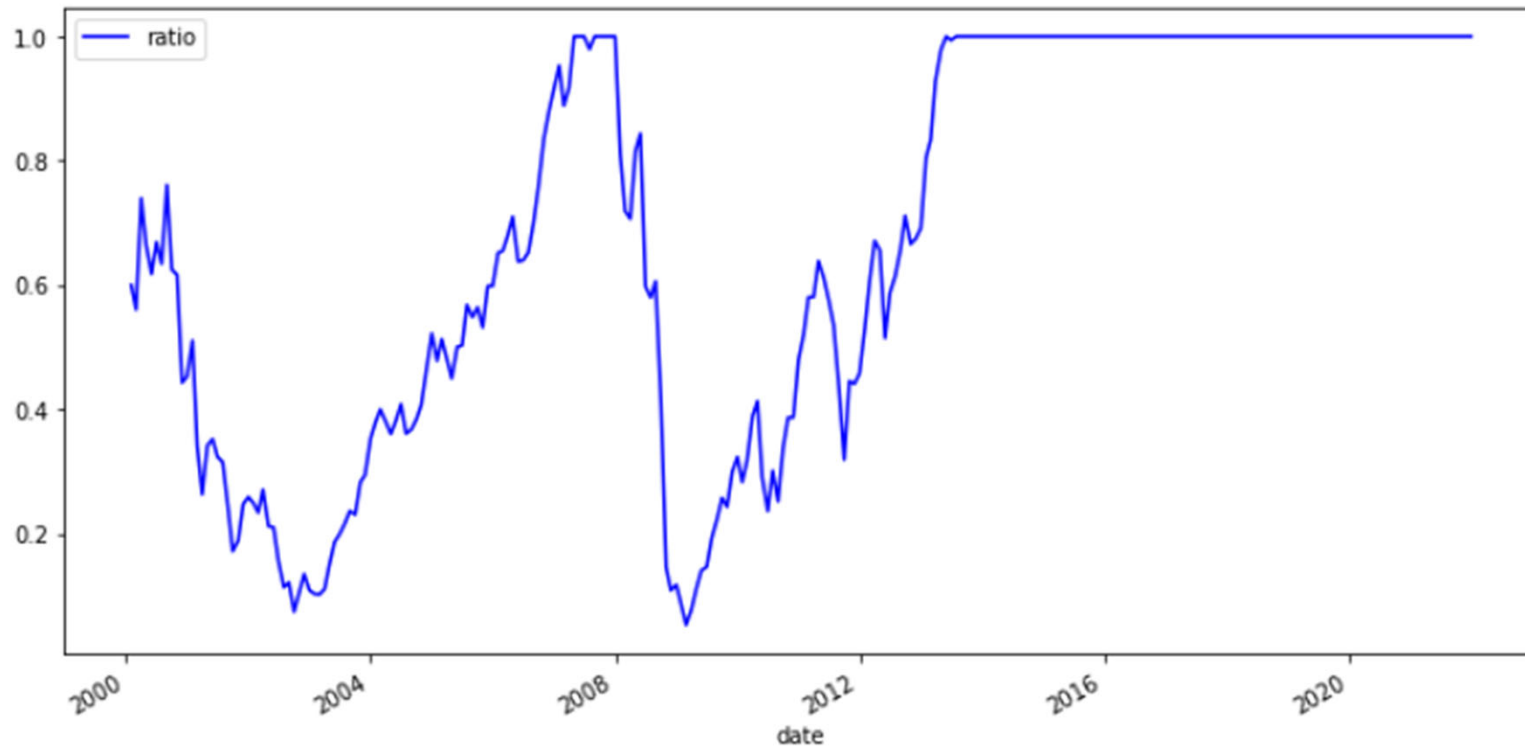
TIPP (python)

	date	sp500	ret	stock100	CPPI	floor	cushion	stock	CMA	ratio
0	2000-01-31	1394.46	NaN	10000.000000	10000.000000	8500.000000	1500.000000	6000.000000	4000.000000	0.600000
1	2000-02-29	1366.42	-0.020108	9798.918578	9886.017813	8500.000000	1386.017813	5544.071253	4341.946560	0.560799
2	2000-03-31	1498.58	0.096720	10746.668961	10429.476385	8865.054927	1564.421458	6257.685831	4171.790554	0.600000
3	2000-04-28	1452.43	-0.030796	10415.716478	10243.718802	8865.054927	1378.663875	5514.655501	4729.063301	0.538345
4	2000-05-31	1420.60	-0.021915	10187.456076	10130.746912	8865.054927	1265.691985	5062.767941	5067.978971	0.499743
...	...	...	...	...	...	...	...	...	...	...
259	2021-08-31	4522.68	0.028990	32433.199948	23112.895450	19645.961133	3466.934318	13867.737270	9245.158180	0.600000
260	2021-09-30	4307.54	-0.047569	30890.380506	22468.627706	19645.961133	2822.666573	11290.666292	11177.961414	0.502508
261	2021-10-29	4605.38	0.069144	33026.261062	23267.938041	19777.747335	3490.190706	13960.762825	9307.175216	0.600000
262	2021-11-30	4567.00	-0.008334	32751.029072	23167.104752	19777.747335	3389.357417	13557.429668	9609.675084	0.585202
263	2021-12-31	4766.18	0.043613	34179.395608	23774.399362	20208.239458	3566.159904	14264.639617	9509.759745	0.600000

TIPP figure (python)

Stock weight (python)