Engineered Feature EDA

Tickers: PSX, VLO, MPC, ^GSPC, CL=F, GC=F, ^VIX

CL=F • Schema & Missingness

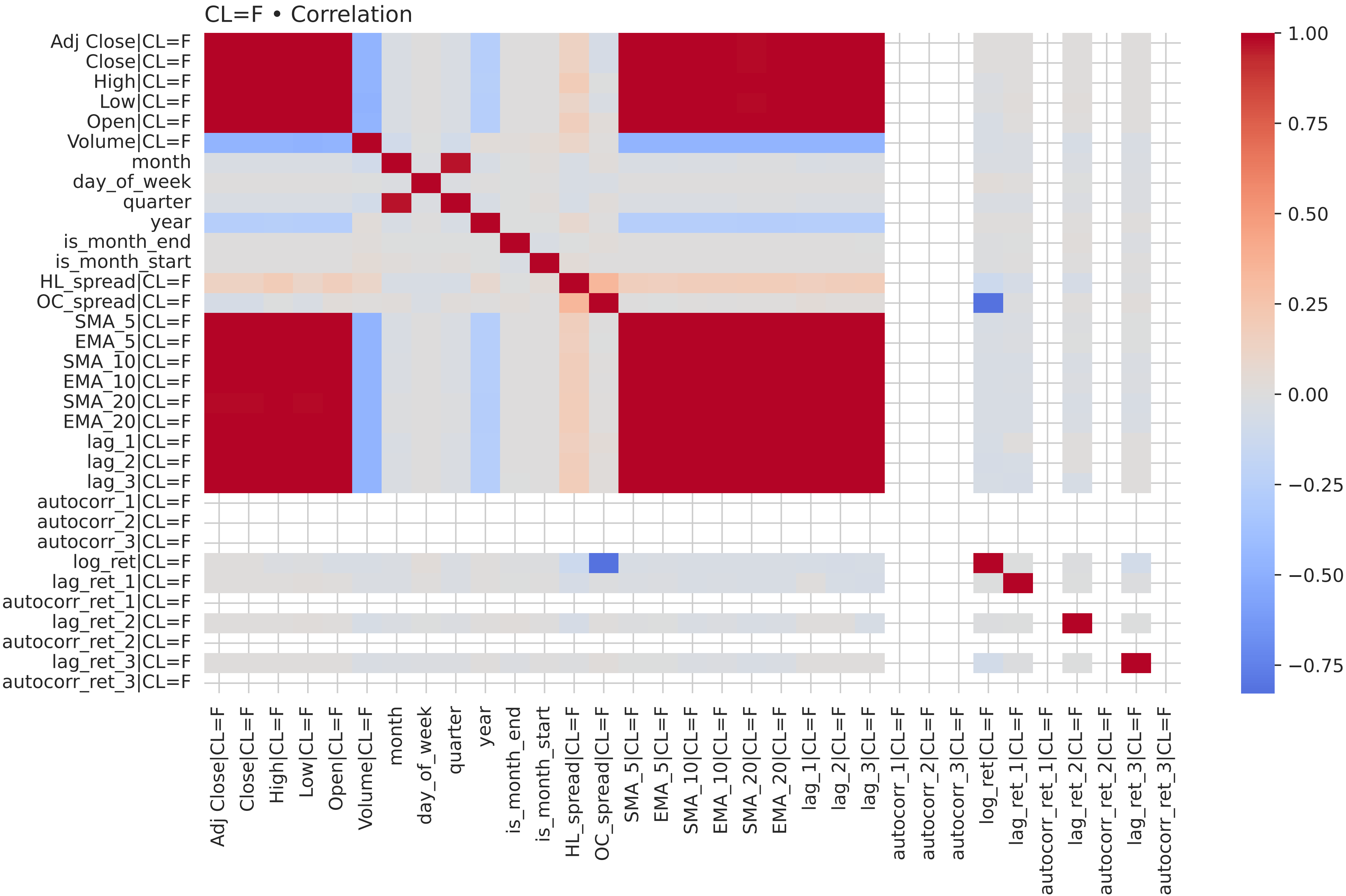
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|CL=F	float64	3770	0	0.0	2992	96.97
Close|CL=F	float64	3770	0	0.0	2992	96.97
High|CL=F	float64	3770	0	0.0	2924	99.96
Low|CL=F	float64	3770	0	0.0	2945	96.71
Open|CL=F	float64	3770	0	0.0	2939	98.5
Volume|CL=F	int64	3770	0	0.0	3751	262001.0
month	int32	3770	0	0.0	12	2.0
day_of_week	int32	3770	0	0.0	5	0.0
quarter	int32	3770	0	0.0	4	1.0
year	int32	3770	0	0.0	16	2011.0
is_month_end	int64	3770	0	0.0	2	1.0
is_month_start	int64	3770	0	0.0	2	0.0
HL_spread|CL=F	float64	3770	0	0.0	1718	3.25
OC_spread|CL=F	float64	3770	0	0.0	2004	1.53
SMA_5|CL=F	float64	3770	0	0.0	3693	96.97
EMA_5|CL=F	float64	3770	0	0.0	3770	96.97
SMA_10|CL=F	float64	3770	0	0.0	3736	96.97
EMA_10|CL=F	float64	3770	0	0.0	3770	96.97
SMA_20|CL=F	float64	3770	0	0.0	3759	96.97
EMA_20|CL=F	float64	3770	0	0.0	3770	96.97
lag_1|CL=F	float64	3769	1	0.03	2991	96.97
lag_2|CL=F	float64	3768	2	0.05	2991	96.97
lag_3|CL=F	float64	3767	3	0.08	2990	96.97
autocorr_1|CL=F	float64	3770	0	0.0	1	0.9958
autocorr_2|CL=F	float64	3770	0	0.0	1	0.993
autocorr_3|CL=F	float64	3770	0	0.0	1	0.9905
log_ret|CL=F	float64	3767	3	0.08	3754	0.0271
lag_ret_1|CL=F	float64	3766	4	0.11	3753	0.0271
autocorr_ret_1|CL=F	float64	3770	0	0.0	1	0.0006
lag_ret_2|CL=F	float64	3765	5	0.13	3752	0.0271
autocorr_ret_2|CL=F	float64	3770	0	0.0	1	-0.008
lag_ret_3|CL=F	float64	3764	6	0.16	3751	0.0271
autocorr_ret_3|CL=F	float64	3770	0	0.0	1	-0.0806

CL=F • Numeric Quality

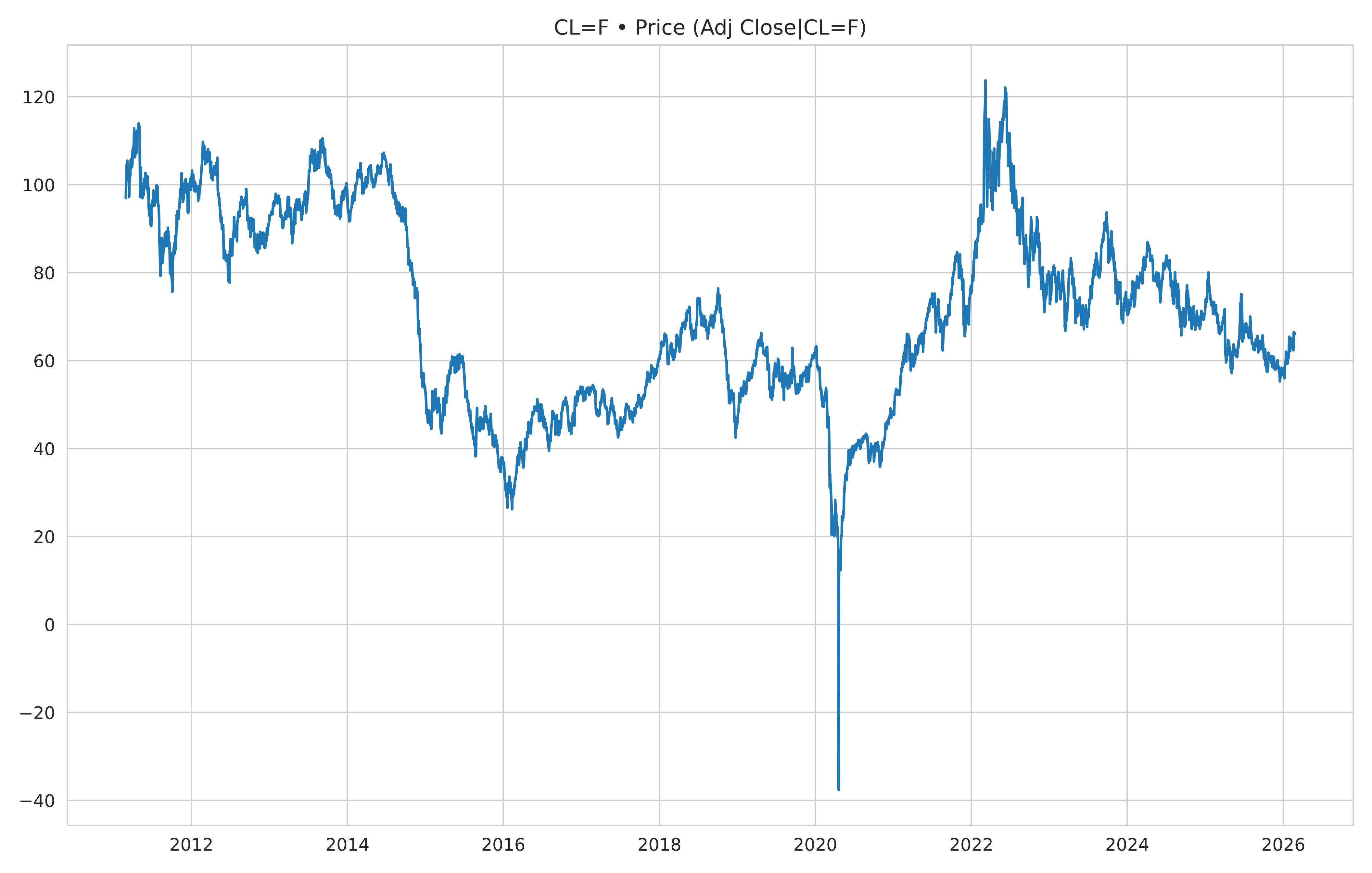
Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
dj Close|CL=F	3770	0.0	0	1	-37.63	25.987	53.29	69.205	70.7328	88.8875	110.774	123.7	21.2664
Close|CL=F	3770	0.0	0	1	-37.63	25.987	53.29	69.205	70.7328	88.8875	110.774	123.7	21.2664
High|CL=F	3770	0.0	0	0	13.69	27.9383	54.0525	70.225	71.812	90.1375	113.1924	130.5	21.3564
Low|CL=F	3770	0.0	0	2	-40.32	24.6133	52.58	68.215	69.623	87.425	108.6924	120.79	21.0996
Open|CL=F	3770	0.0	0	1	-14.0	26.2211	53.295	69.295	70.7695	88.7875	110.6831	124.66	21.2384
Volume|CL=F	3770	0.0	6	0	0.0	79902.83	258405.75	343488.5	397469.6244	512423.0	1001539.7	2288230.0	205762.9221
month	3770	0.0	0	0	1.0	1.0	4.0	7.0	6.5432	10.0	12.0	12.0	3.426
day_of_week	3770	0.0	705	0	0.0	0.0	1.0	2.0	2.0236	3.0	4.0	4.0	1.3998
quarter	3770	0.0	0	0	1.0	1.0	2.0	3.0	2.5143	4.0	4.0	4.0	1.114
year	3770	0.0	0	0	2011.0	2011.0	2014.0	2018.0	2018.1483	2022.0	2025.0	2026.0	4.3334
s_month_end	3770	0.0	3643	0	0.0	0.0	0.0	0.0	0.0337	0.0	1.0	1.0	0.1804
s_month_start	3770	0.0	3655	0	0.0	0.0	0.0	0.0	0.0305	0.0	1.0	1.0	0.172
_spread|CL=F	3770	0.0	0	0	0.48	0.6669	1.36	1.845	2.189	2.58	7.2127	58.17	1.6745
_spread|CL=F	3770	0.0	16	1946	-24.01	-3.6031	-0.8	-0.05	0.0366	0.8	4.1689	55.36	1.7688
SMA_5|CL=F	3770	0.0	0	0	3.92	25.6331	53.2275	69.303	70.7498	89.0085	110.7034	120.926	21.2172
EMA_5|CL=F	3770	0.0	0	0	0.8439	25.4147	53.3206	69.4067	70.7494	88.7959	110.3352	120.4604	21.1964
SMA_10|CL=F	3770	0.0	0	0	9.689	26.5269	53.286	69.661	70.7737	88.886	109.321	119.383	21.1854
EMA_10|CL=F	3770	0.0	0	0	10.5557	27.0267	53.3922	69.6452	70.7709	88.5864	109.4496	118.8597	21.1415
SMA_20|CL=F	3770	0.0	0	0	15.709	27.2507	53.4326	69.774	70.8237	88.8302	108.8974	116.281	21.1333
EMA_20|CL=F	3770	0.0	0	0	16.034	27.818	53.5862	69.723	70.8159	88.5085	108.2449	116.1898	21.0334
ag_1|CL=F	3769	0.03	0	1	-37.63	25.984	53.29	69.21	70.7341	88.9	110.778	123.7	21.2691
ag_2|CL=F	3768	0.05	0	1	-37.63	25.981	53.285	69.21	70.7352	88.9025	110.782	123.7	21.2718
ag_3|CL=F	3767	0.08	0	1	-37.63	25.978	53.28	69.21	70.7364	88.905	110.786	123.7	21.2745
ocorr_1|CL=F	3770	0.0	0	0	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958	0.0
ocorr_2|CL=F	3770	0.0	0	0	0.993	0.993	0.993	0.993	0.993	0.993	0.993	0.993	0.0
ocorr_3|CL=F	3770	0.0	0	0	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905	0.0
log_ret|CL=F	3767	0.08	12	1788	-0.2822	-0.0682	-0.0118	0.001	0.0001	0.0123	0.06	0.3196	0.0259
g_ret_1|CL=F	3766	0.11	12	1787	-0.2822	-0.0683	-0.0118	0.001	0.0001	0.0123	0.06	0.3196	0.0259
rr_ret_1|CL=F	3770	0.0	0	0	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0
g_ret_2|CL=F	3765	0.13	12	1786	-0.2822	-0.0683	-0.0118	0.001	0.0001	0.0123	0.0601	0.3196	0.0259
rr_ret_2|CL=F	3770	0.0	0	3770	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	0.0
g_ret_3|CL=F	3764	0.16	12	1785	-0.2822	-0.0683	-0.0118	0.001	0.0001	0.0123	0.0601	0.3196	0.0259
rr_ret_3|CL=F	3770	0.0	0	3770	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	0.0

CL=F • Describe

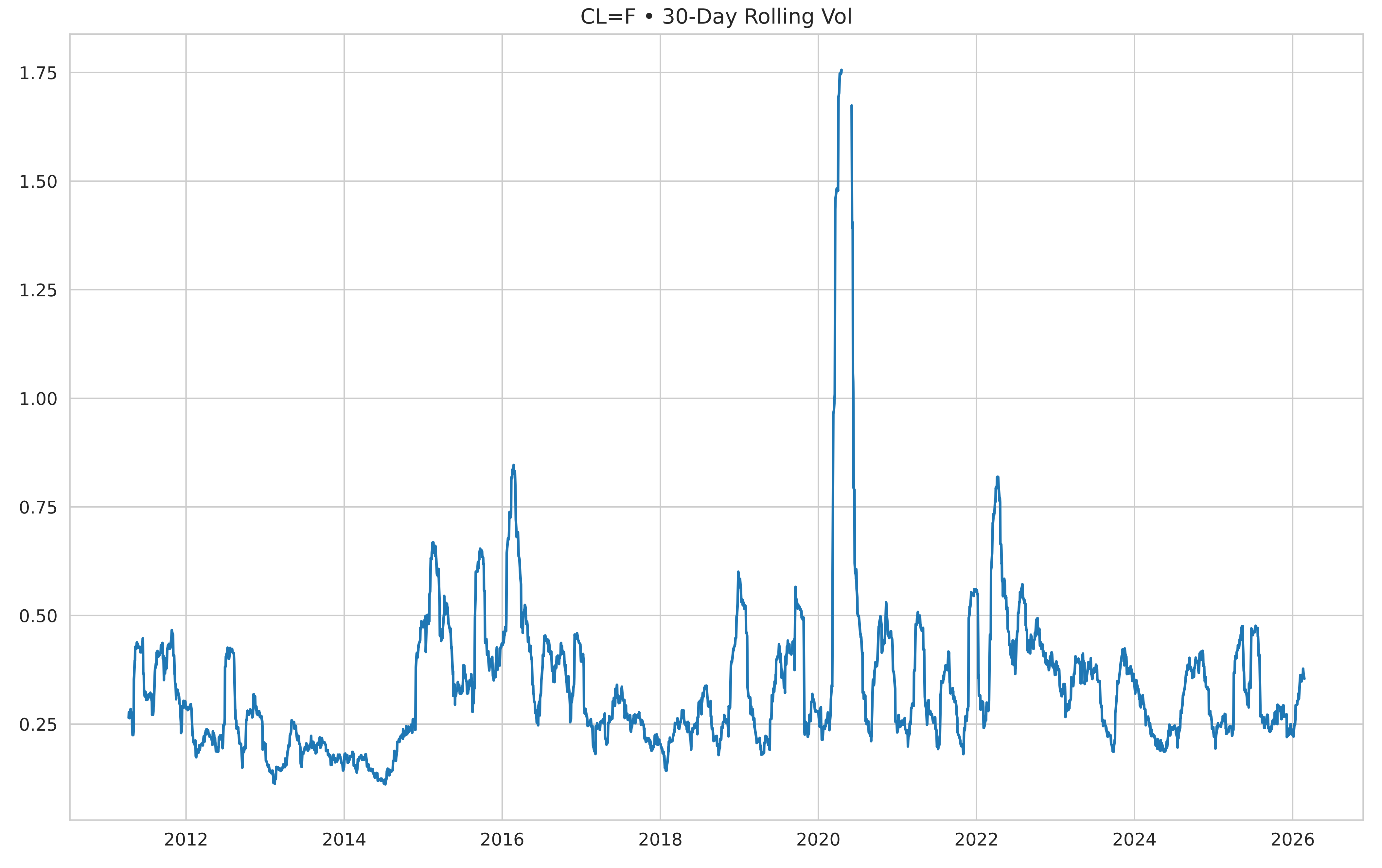
Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
dj Close|CL=F	3770.0	70.7328	21.2664	-37.63	25.987	39.7845	53.29	69.205	88.8875	104.42	110.774	123.7
Close|CL=F	3770.0	70.7328	21.2664	-37.63	25.987	39.7845	53.29	69.205	88.8875	104.42	110.774	123.7
High|CL=F	3770.0	71.812	21.3564	13.69	27.9383	40.5345	54.0525	70.225	90.1375	105.6575	113.1924	130.5
Low|CL=F	3770.0	69.623	21.0996	-40.32	24.6133	38.8545	52.58	68.215	87.425	103.267	108.6924	120.79
Open|CL=F	3770.0	70.7695	21.2384	-14.0	26.2211	39.6945	53.295	69.295	88.7875	104.4975	110.6831	124.66
Volume|CL=F	3770.0	397469.6244	205762.9221	0.0	79902.83	122621.8	258405.75	343488.5	512423.0	784563.15	1001539.7	2288230.0
month	3770.0	6.5432	3.426	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3770.0	2.0236	1.3998	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3770.0	2.5143	1.114	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3770.0	2018.1483	4.3334	2011.0	2011.0	2011.0	2014.0	2018.0	2022.0	2025.0	2025.0	2026.0
is_month_end	3770.0	0.0337	0.1804	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3770.0	0.0305	0.172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
_spread|CL=F	3770.0	2.189	1.6745	0.48	0.6669	0.89	1.36	1.845	2.58	4.4855	7.2127	58.17
C_spread|CL=F	3770.0	0.0366	1.7688	-24.01	-3.6031	-2.06	-0.8	-0.05	0.8	2.35	4.1689	55.36
SMA_5|CL=F	3770.0	70.7498	21.2172	3.92	25.6331	39.8232	53.2275	69.303	89.0085	104.5371	110.7034	120.926
EMA_5|CL=F	3770.0	70.7494	21.1964	0.8439	25.4147	39.754	53.3206	69.4067	88.7959	104.2177	110.3352	120.4604
SMA_10|CL=F	3770.0	70.7737	21.1854	9.689	26.5269	39.6183	53.286	69.661	88.886	104.6447	109.321	119.383
EMA_10|CL=F	3770.0	70.7709	21.1415	10.5557	27.0267	39.7146	53.3922	69.6452	88.5864	104.3928	109.4496	118.8597
SMA_20|CL=F	3770.0	70.8237	21.1333	15.709	27.2507	39.5982	53.4326	69.774	88.8302	104.2925	108.8974	116.281
EMA_20|CL=F	3770.0	70.8159	21.0334	16.034	27.818	39.7118	53.5862	69.723	88.5085	104.0618	108.2449	116.1898
lag_1|CL=F	3769.0	70.7341	21.2691	-37.63	25.984	39.784	53.29	69.21	88.9	104.42	110.778	123.7
lag_2|CL=F	3768.0	70.7352	21.2718	-37.63	25.981	39.7835	53.285	69.21	88.9025	104.42	110.782	123.7
lag_3|CL=F	3767.0	70.7364	21.2745	-37.63	25.978	39.783	53.28	69.21	88.905	104.42	110.786	123.7
tocorr_1|CL=F	3770.0	0.9958	0.0	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958	0.9958
tocorr_2|CL=F	3770.0	0.993	0.0	0.993	0.993	0.993	0.993	0.993	0.993	0.993	0.993	0.993
tocorr_3|CL=F	3770.0	0.9905	0.0	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905	0.9905
log_ret|CL=F	3767.0	0.0001	0.0259	-0.2822	-0.0682	-0.0374	-0.0118	0.001	0.0123	0.0333	0.06	0.3196
ag_ret_1|CL=F	3766.0	0.0001	0.0259	-0.2822	-0.0683	-0.0374	-0.0118	0.001	0.0123	0.0333	0.06	0.3196
orr_ret_1|CL=F	3770.0	0.0006	0.0	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
ag_ret_2|CL=F	3765.0	0.0001	0.0259	-0.2822	-0.0683	-0.0374	-0.0118	0.001	0.0123	0.0333	0.0601	0.3196
orr_ret_2|CL=F	3770.0	-0.008	0.0	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
ag_ret_3|CL=F	3764.0	0.0001	0.0259	-0.2822	-0.0683	-0.0374	-0.0118	0.001	0.0123	0.0333	0.0601	0.3196
orr_ret_3|CL=F	3770.0	-0.0806	0.0	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806	-0.0806



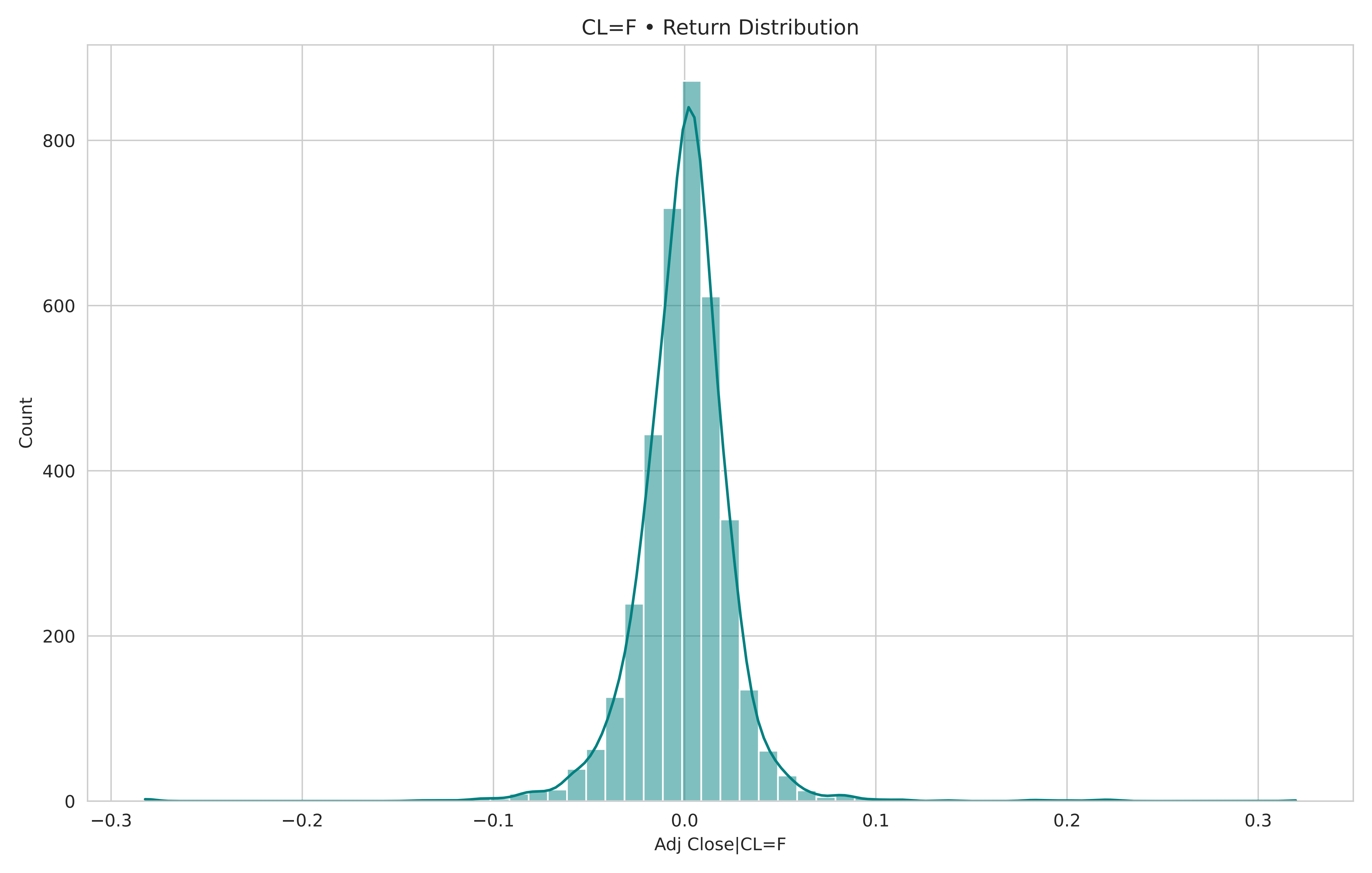
CL=F • Correlation
Adj Close|CL=F
Close|CL=F
High|CL=F
Low|CL=F
Open|CL=F
Volume|CL=F
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|CL=F
OC_spread|CL=F
SMA_5|CL=F
EMA_5|CL=F
SMA_10|CL=F
EMA_10|CL=F
SMA_20|CL=F
EMA_20|CL=F
lag_1|CL=F
lag_2|CL=F
lag_3|CL=F
autocorr_1|CL=F
autocorr_2|CL=F
autocorr_3|CL=F
log_ret|CL=F
lag_ret_1|CL=F
autocorr_ret_1|CL=F
lag_ret_2|CL=F
autocorr_ret_2|CL=F
lag_ret_3|CL=F
autocorr_ret_3|CL=F
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75



CL=F • Price (Adj Close|CL=F)
120
100
80
60
40
20
0
−20
−40
2012
2014
2016
2018
2020
2022
2024
2026



CL=F • 30-Day Rolling Vol
1.75
1.50
1.25
1.00
0.75
0.50
0.25
2012
2014
2016
2018
2020
2022
2024
2026


CL=F • Return Distribution
Count
0
200
400
600
800
−0.3
−0.2
−0.1
0.0
0.1
0.2
0.3
Adj Close|CL=F

GC=F • Schema & Missingness

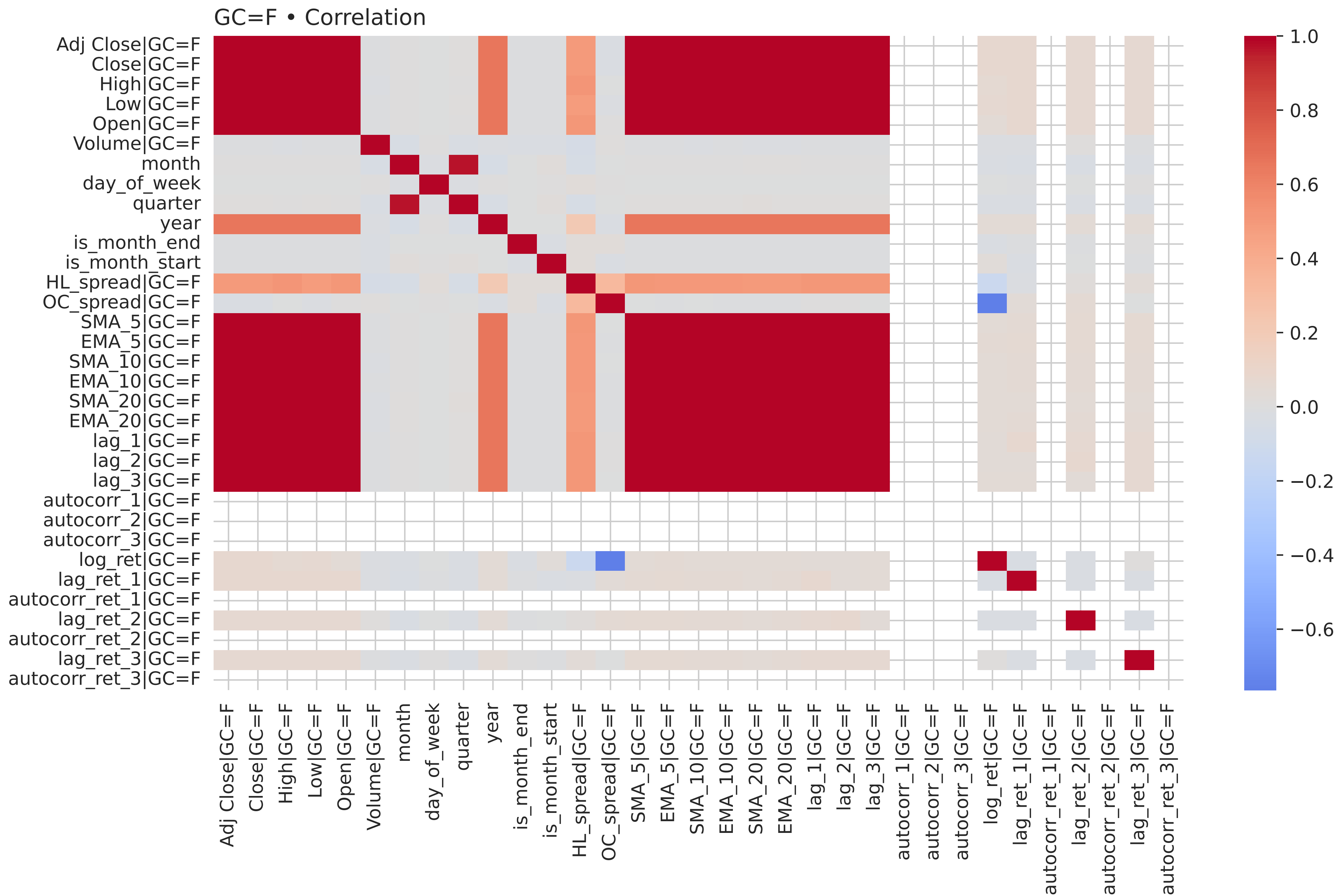
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|GC=F	float64	3769	0	0.0	3106	1409.3
Close|GC=F	float64	3769	0	0.0	3106	1409.3
High|GC=F	float64	3769	0	0.0	3116	1415.7
Low|GC=F	float64	3769	0	0.0	3118	1407.7
Open|GC=F	float64	3769	0	0.0	3101	1410.7
Volume|GC=F	int64	3769	0	0.0	1319	205.0
month	int32	3769	0	0.0	12	2.0
day_of_week	int32	3769	0	0.0	5	0.0
quarter	int32	3769	0	0.0	4	1.0
year	int32	3769	0	0.0	16	2011.0
is_month_end	int64	3769	0	0.0	2	1.0
is_month_start	int64	3769	0	0.0	2	0.0
HL_spread|GC=F	float64	3769	0	0.0	1165	8.0
OC_spread|GC=F	float64	3769	0	0.0	1350	1.3999
SMA_5|GC=F	float64	3769	0	0.0	3714	1409.3
EMA_5|GC=F	float64	3769	0	0.0	3769	1409.3
SMA_10|GC=F	float64	3769	0	0.0	3741	1409.3
EMA_10|GC=F	float64	3769	0	0.0	3769	1409.3
SMA_20|GC=F	float64	3769	0	0.0	3758	1409.3
EMA_20|GC=F	float64	3769	0	0.0	3769	1409.3
lag_1|GC=F	float64	3768	1	0.03	3105	1409.3
lag_2|GC=F	float64	3767	2	0.05	3104	1409.3
lag_3|GC=F	float64	3766	3	0.08	3103	1409.3
autocorr_1|GC=F	float64	3769	0	0.0	1	0.9993
autocorr_2|GC=F	float64	3769	0	0.0	1	0.9987
autocorr_3|GC=F	float64	3769	0	0.0	1	0.9983
log_ret|GC=F	float64	3768	1	0.03	3752	0.0151
lag_ret_1|GC=F	float64	3767	2	0.05	3751	0.0151
autocorr_ret_1|GC=F	float64	3769	0	0.0	1	-0.0335
lag_ret_2|GC=F	float64	3766	3	0.08	3750	0.0151
autocorr_ret_2|GC=F	float64	3769	0	0.0	1	-0.0218
lag_ret_3|GC=F	float64	3765	4	0.11	3749	0.0151
autocorr_ret_3|GC=F	float64	3769	0	0.0	1	0.0143

GC=F • Numeric Quality

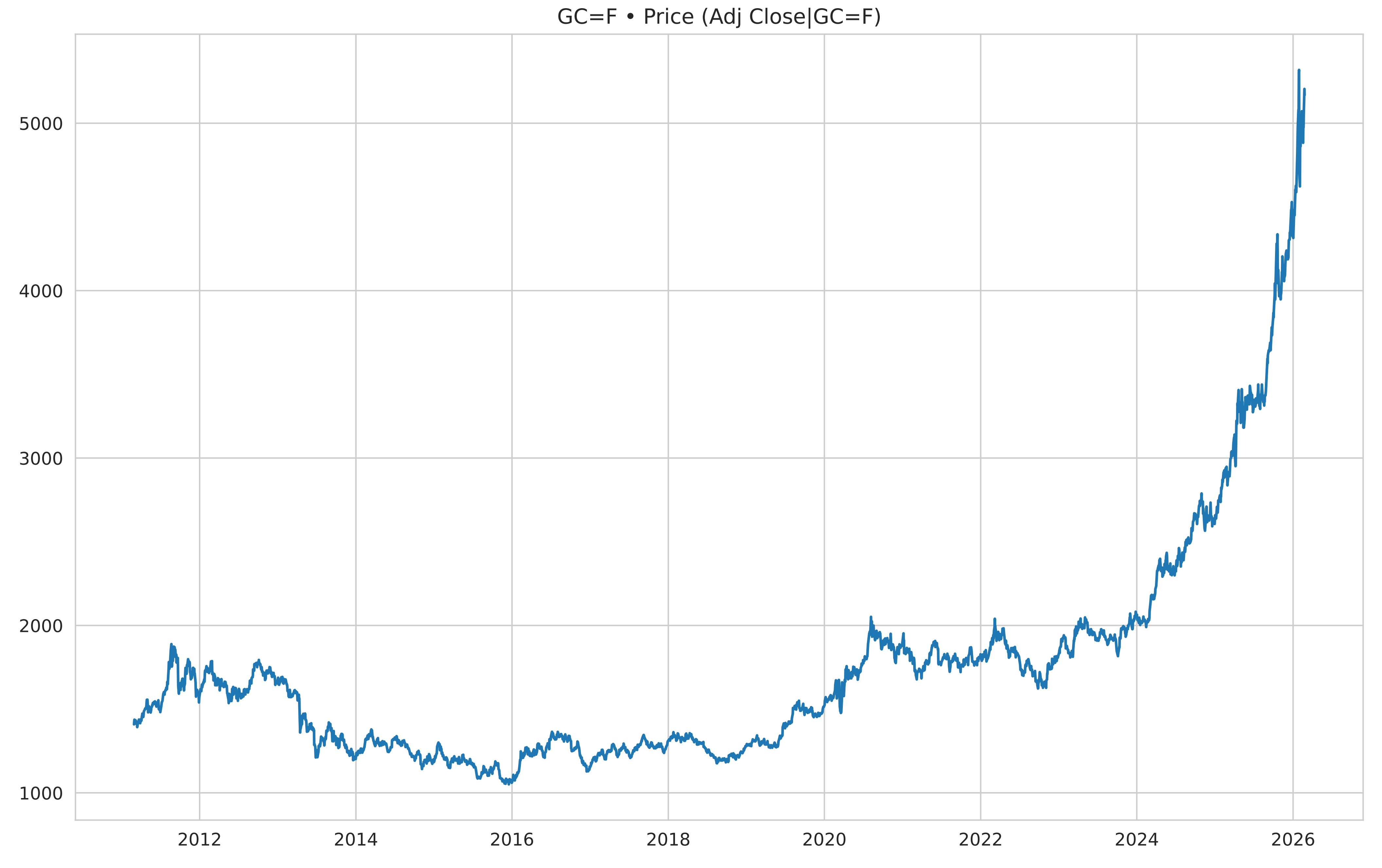
Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
dj Close|GC=F	3769	0.0	0	0	1050.8	1085.312	1281.3	1589.0	1726.6661	1862.9	4439.364	5318.3999	666.8598
Close|GC=F	3769	0.0	0	0	1050.8	1085.312	1281.3	1589.0	1726.6661	1862.9	4439.364	5318.3999	666.8598
High|GC=F	3769	0.0	0	0	1062.0	1091.468	1286.0	1596.0	1735.9846	1870.5	4444.812	5586.2002	673.0084
Low|GC=F	3769	0.0	0	0	1046.2	1080.8	1276.9	1576.8	1717.0326	1853.6	4375.484	5301.6001	660.3167
Open|GC=F	3769	0.0	0	0	1053.7	1084.968	1281.4	1588.5	1726.578	1864.7	4376.3641	5415.7002	666.6428
Volume|GC=F	3769	0.0	40	0	0.0	0.0	49.0	187.0	5207.6959	592.0	180760.44	386334.02	7965.5983
month	3769	0.0	0	0	1.0	1.0	4.0	7.0	6.5447	10.0	12.0	12.0	3.4253
day_of_week	3769	0.0	704	0	0.0	0.0	1.0	2.0	2.0241	3.0	4.0	4.0	1.3996
quarter	3769	0.0	0	0	1.0	1.0	2.0	3.0	2.5147	4.0	4.0	4.0	1.1139
year	3769	0.0	0	0	2011.0	2011.0	2014.0	2018.0	2018.1483	2022.0	2025.0	2026.0	4.334
s_month_end	3769	0.0	3642	0	0.0	0.0	0.0	0.0	0.0337	0.0	1.0	1.0	0.1805
s_month_start	3769	0.0	3654	0	0.0	0.0	0.0	0.0	0.0305	0.0	1.0	1.0	0.172
spread|GC=F	3769	0.0	172	0	0.0	0.0	7.7	13.7999	18.952	23.1001	101.032	740.5	25.3373
spread|GC=F	3769	0.0	207	1822	-223.7002	-50.852	-7.1	0.0	-0.0882	6.1	54.156	662.5	21.7948
SMA_5|GC=F	3769	0.0	0	0	1060.34	1085.7888	1281.52	1588.14	1724.6915	1858.5	4397.2464	5151.1601	661.9165
EMA_5|GC=F	3769	0.0	0	0	1061.8251	1087.4661	1281.1899	1589.7902	1724.7069	1859.2671	4403.3996	5161.4317	661.8889
SMA_10|GC=F	3769	0.0	0	0	1066.77	1085.0284	1281.36	1588.78	1722.3166	1855.17	4393.8248	5029.94	656.2551
EMA_10|GC=F	3769	0.0	0	0	1066.7509	1086.3157	1280.4863	1590.9764	1722.3217	1858.4348	4375.6469	5048.0134	656.095
SMA_20|GC=F	3769	0.0	0	0	1068.855	1087.3932	1280.715	1590.86	1717.6134	1859.255	4309.4728	5001.165	645.0487
EMA_20|GC=F	3769	0.0	0	0	1071.4439	1089.3392	1282.0756	1594.3486	1717.6857	1859.2905	4323.3336	4972.1911	644.9698
lag_1|GC=F	3768	0.03	0	0	1050.8	1085.303	1281.3	1588.8	1725.7526	1862.825	4392.144	5318.3999	664.5853
lag_2|GC=F	3767	0.05	0	0	1050.8	1085.294	1281.3	1588.6	1724.829	1862.4	4364.358	5318.3999	662.2509
lag_3|GC=F	3766	0.08	0	0	1050.8	1085.285	1281.3	1588.5	1723.9436	1861.95	4352.365	5318.3999	660.1051
ocorr_1|GC=F	3769	0.0	0	0	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.0
ocorr_2|GC=F	3769	0.0	0	0	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.0
ocorr_3|GC=F	3769	0.0	0	0	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.0
log_ret|GC=F	3768	0.03	13	1781	-0.1207	-0.0287	-0.0045	0.0004	0.0003	0.0059	0.0275	0.0591	0.0106
g_ret_1|GC=F	3767	0.05	13	1780	-0.1207	-0.0287	-0.0045	0.0004	0.0003	0.0059	0.0275	0.0591	0.0106
r_ret_1|GC=F	3769	0.0	0	3769	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	0.0
g_ret_2|GC=F	3766	0.08	13	1780	-0.1207	-0.0287	-0.0045	0.0004	0.0003	0.0059	0.0271	0.0591	0.0106
r_ret_2|GC=F	3769	0.0	0	3769	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	0.0
g_ret_3|GC=F	3765	0.11	13	1780	-0.1207	-0.0287	-0.0045	0.0004	0.0003	0.0059	0.0271	0.0591	0.0106
r_ret_3|GC=F	3769	0.0	0	0	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143	0.0

GC=F • Describe

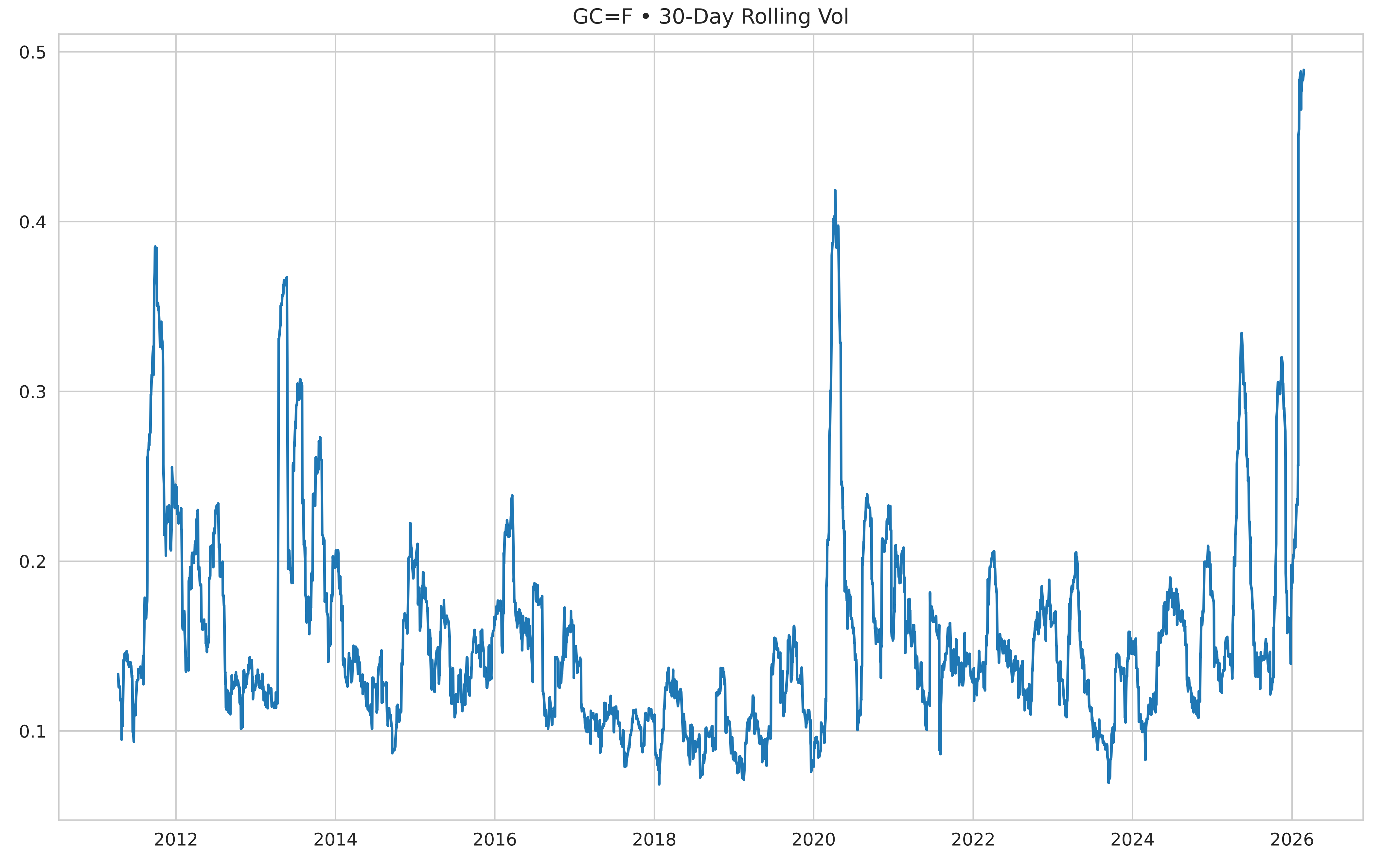
Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
dj Close|GC=F	3769.0	1726.6661	666.8598	1050.8	1085.312	1171.66	1281.3	1589.0	1862.9	3312.68	4439.364	5318.3999
Close|GC=F	3769.0	1726.6661	666.8598	1050.8	1085.312	1171.66	1281.3	1589.0	1862.9	3312.68	4439.364	5318.3999
High|GC=F	3769.0	1735.9846	673.0084	1062.0	1091.468	1177.3	1286.0	1596.0	1870.5	3333.42	4444.812	5586.2002
Low|GC=F	3769.0	1717.0326	660.3167	1046.2	1080.8	1165.52	1276.9	1576.8	1853.6	3289.48	4375.484	5301.6001
Open|GC=F	3769.0	1726.578	666.6428	1053.7	1084.968	1172.34	1281.4	1588.5	1864.7	3314.5801	4376.3641	5415.7002
Volume|GC=F	3769.0	5207.6959	27965.5983	0.0	0.0	6.0	49.0	187.0	592.0	6269.4	180760.44	386334.0
month	3769.0	6.5447	3.4253	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3769.0	2.0241	1.3996	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3769.0	2.5147	1.1139	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3769.0	2018.1483	4.334	2011.0	2011.0	2011.0	2014.0	2018.0	2022.0	2025.0	2025.0	2026.0
is_month_end	3769.0	0.0337	0.1805	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3769.0	0.0305	0.172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
_spread|GC=F	3769.0	18.952	25.3373	0.0	0.0	0.44	7.7	13.7999	23.1001	49.46	101.032	740.5
_spread|GC=F	3769.0	-0.0882	21.7948	-223.7002	-50.852	-25.3	-7.1	0.0	6.1	25.66	54.156	662.5
SMA_5|GC=F	3769.0	1724.6915	661.9165	1060.34	1085.7888	1172.452	1281.52	1588.14	1858.5	3314.028	4397.2464	5151.1601
EMA_5|GC=F	3769.0	1724.7069	661.8889	1061.8251	1087.4661	1173.9081	1281.1899	1589.7902	1859.2671	3318.0926	4403.3996	5161.4317
SMA_10|GC=F	3769.0	1722.3166	656.2551	1066.77	1085.0284	1173.36	1281.36	1588.78	1855.17	3310.838	4393.8248	5029.94
EMA_10|GC=F	3769.0	1722.3217	656.095	1066.7509	1086.3157	1175.1619	1280.4863	1590.9764	1858.4348	3301.3614	4375.6469	5048.0134
SMA_20|GC=F	3769.0	1717.6134	645.0487	1068.855	1087.3932	1177.32	1280.715	1590.86	1859.255	3291.138	4309.4728	5001.165
EMA_20|GC=F	3769.0	1717.6857	644.9698	1071.4439	1089.3392	1180.9349	1282.0756	1594.3486	1859.2905	3273.6737	4323.3336	4972.1911
lag_1|GC=F	3768.0	1725.7526	664.5853	1050.8	1085.303	1171.64	1281.3	1588.8	1862.825	3311.4951	4392.144	5318.3999
lag_2|GC=F	3767.0	1724.829	662.2509	1050.8	1085.294	1171.62	1281.3	1588.6	1862.4	3310.7	4364.358	5318.3999
lag_3|GC=F	3766.0	1723.9436	660.1051	1050.8	1085.285	1171.6	1281.3	1588.5	1861.95	3309.2501	4352.365	5318.3999
tocorr_1|GC=F	3769.0	0.9993	0.0	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993	0.9993
tocorr_2|GC=F	3769.0	0.9987	0.0	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987
tocorr_3|GC=F	3769.0	0.9983	0.0	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983	0.9983
log_ret|GC=F	3768.0	0.0003	0.0106	-0.1207	-0.0287	-0.0165	-0.0045	0.0004	0.0059	0.0165	0.0275	0.0591
ag_ret_1|GC=F	3767.0	0.0003	0.0106	-0.1207	-0.0287	-0.0165	-0.0045	0.0004	0.0059	0.0165	0.0275	0.0591
rr_ret_1|GC=F	3769.0	-0.0335	0.0	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335	-0.0335
ag_ret_2|GC=F	3766.0	0.0003	0.0106	-0.1207	-0.0287	-0.0165	-0.0045	0.0004	0.0059	0.0165	0.0271	0.0591
rr_ret_2|GC=F	3769.0	-0.0218	0.0	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218	-0.0218
ag_ret_3|GC=F	3765.0	0.0003	0.0106	-0.1207	-0.0287	-0.0165	-0.0045	0.0004	0.0059	0.0164	0.0271	0.0591
rr_ret_3|GC=F	3769.0	0.0143	0.0	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143	0.0143

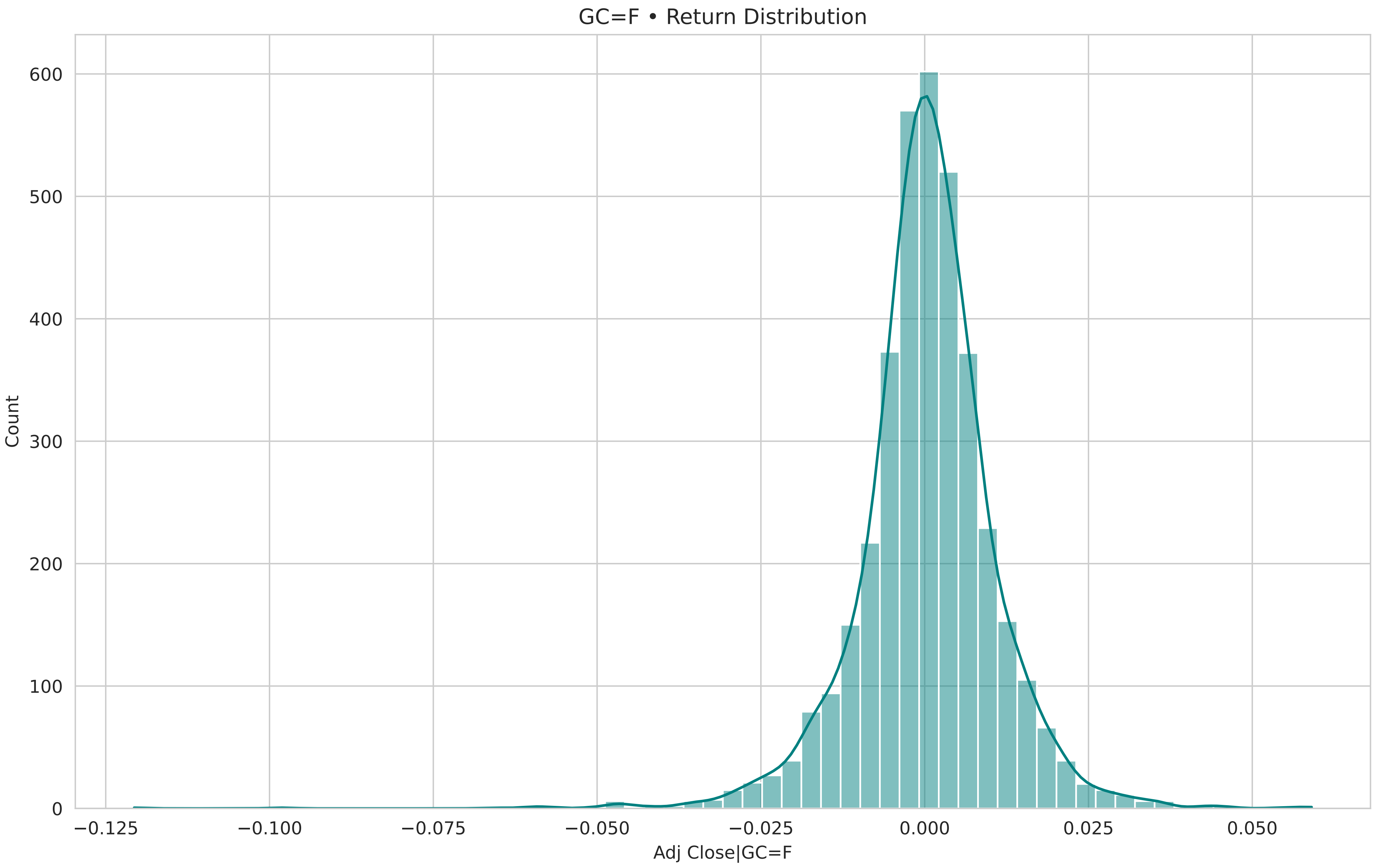


GC=F • Correlation
Adj Close|GC=F
Close|GC=F
High|GC=F
Low|GC=F
Open|GC=F
Volume|GC=F
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|GC=F
OC_spread|GC=F
SMA_5|GC=F
EMA_5|GC=F
SMA_10|GC=F
EMA_10|GC=F
SMA_20|GC=F
EMA_20|GC=F
lag_1|GC=F
lag_2|GC=F
lag_3|GC=F
autocorr_1|GC=F
autocorr_2|GC=F
autocorr_3|GC=F
log_ret|GC=F
lag_ret_1|GC=F
autocorr_ret_1|GC=F
lag_ret_2|GC=F
autocorr_ret_2|GC=F
lag_ret_3|GC=F
autocorr_ret_3|GC=F
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6



GC=F • Price (Adj Close|GC=F)
5000
4000
3000
2000
1000
2012
2014
2016
2018
2020
2022
2024
2026


GC=F • 30-Day Rolling Vol
0.5
0.4
0.3
0.2
0.1
2012
2014
2016
2018
2020
2022
2024
2026



GC=F • Return Distribution
Count
600
500
400
300
200
100
0
−0.125
−0.100
−0.075
−0.050
−0.025
0.000
0.025
0.050
Adj Close|GC=F

MPC • Schema & Missingness

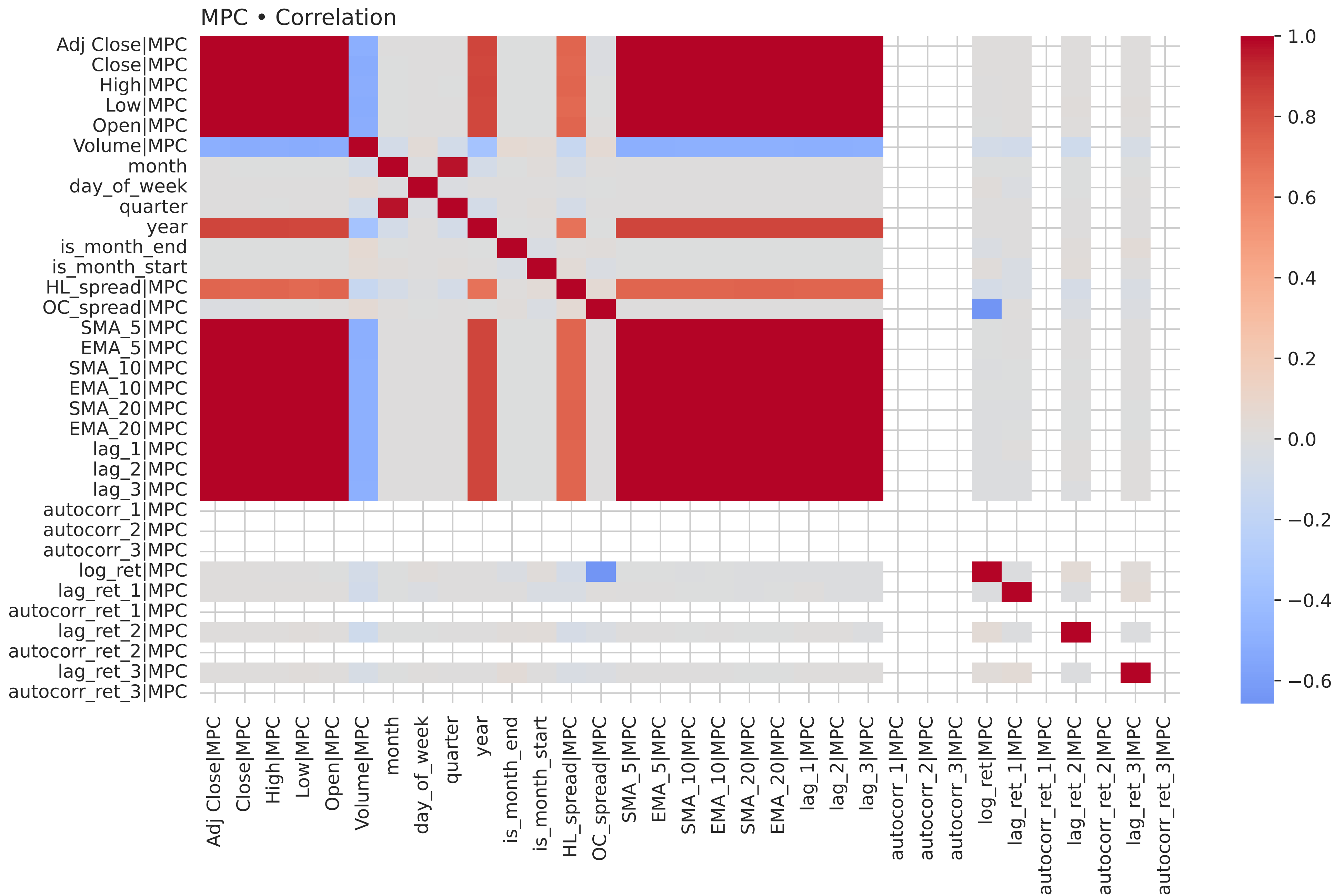
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|MPC	float64	3688	0	0.0	3580	12.2291
Close|MPC	float64	3688	0	0.0	3160	18.625
High|MPC	float64	3688	0	0.0	3211	19.575
Low|MPC	float64	3688	0	0.0	3196	18.42
Open|MPC	float64	3688	0	0.0	3162	19.375
Volume|MPC	int64	3688	0	0.0	3612	1675400.0
month	int32	3688	0	0.0	12	6.0
day_of_week	int32	3688	0	0.0	5	4.0
quarter	int32	3688	0	0.0	4	2.0
year	int32	3688	0	0.0	16	2011.0
is_month_end	int64	3688	0	0.0	2	0.0
is_month_start	int64	3688	0	0.0	2	0.0
HL_spread|MPC	float64	3688	0	0.0	2227	1.155
OC_spread|MPC	float64	3688	0	0.0	2498	0.75
SMA_5|MPC	float64	3688	0	0.0	3684	12.2291
EMA_5|MPC	float64	3688	0	0.0	3688	12.2291
SMA_10|MPC	float64	3688	0	0.0	3685	12.2291
EMA_10|MPC	float64	3688	0	0.0	3688	12.2291
SMA_20|MPC	float64	3688	0	0.0	3686	12.2291
EMA_20|MPC	float64	3688	0	0.0	3688	12.2291
lag_1|MPC	float64	3687	1	0.03	3579	12.2291
lag_2|MPC	float64	3686	2	0.05	3578	12.2291
lag_3|MPC	float64	3685	3	0.08	3577	12.2291
autocorr_1|MPC	float64	3688	0	0.0	1	0.9995
autocorr_2|MPC	float64	3688	0	0.0	1	0.9989
autocorr_3|MPC	float64	3688	0	0.0	1	0.9984
log_ret|MPC	float64	3687	1	0.03	3679	0.0107
lag_ret_1|MPC	float64	3686	2	0.05	3678	0.0107
autocorr_ret_1|MPC	float64	3688	0	0.0	1	-0.01
lag_ret_2|MPC	float64	3685	3	0.08	3677	0.0107
autocorr_ret_2|MPC	float64	3688	0	0.0	1	0.048
lag_ret_3|MPC	float64	3684	4	0.11	3676	0.0107
autocorr_ret_3|MPC	float64	3688	0	0.0	1	0.0284

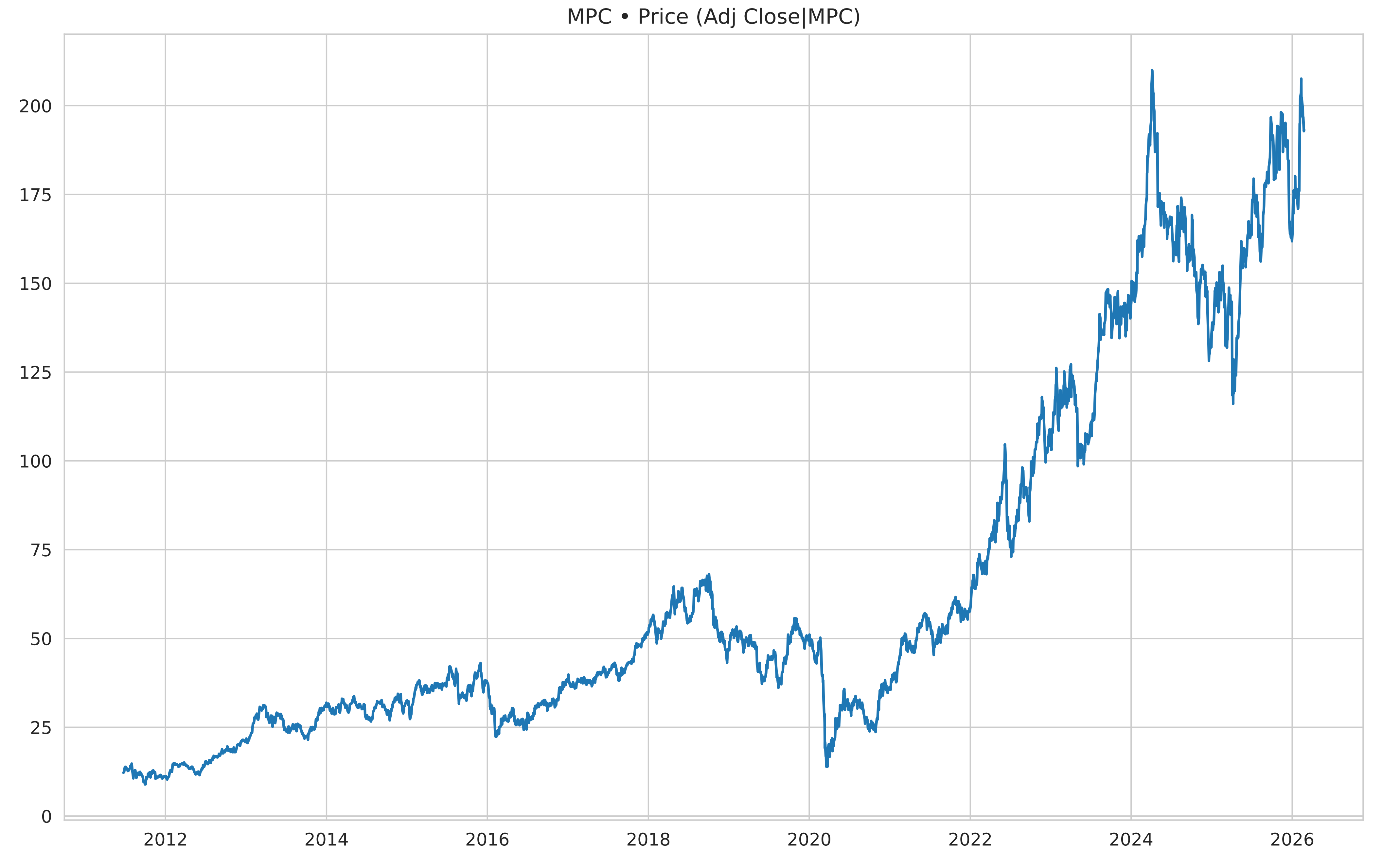
MPC • Numeric Quality

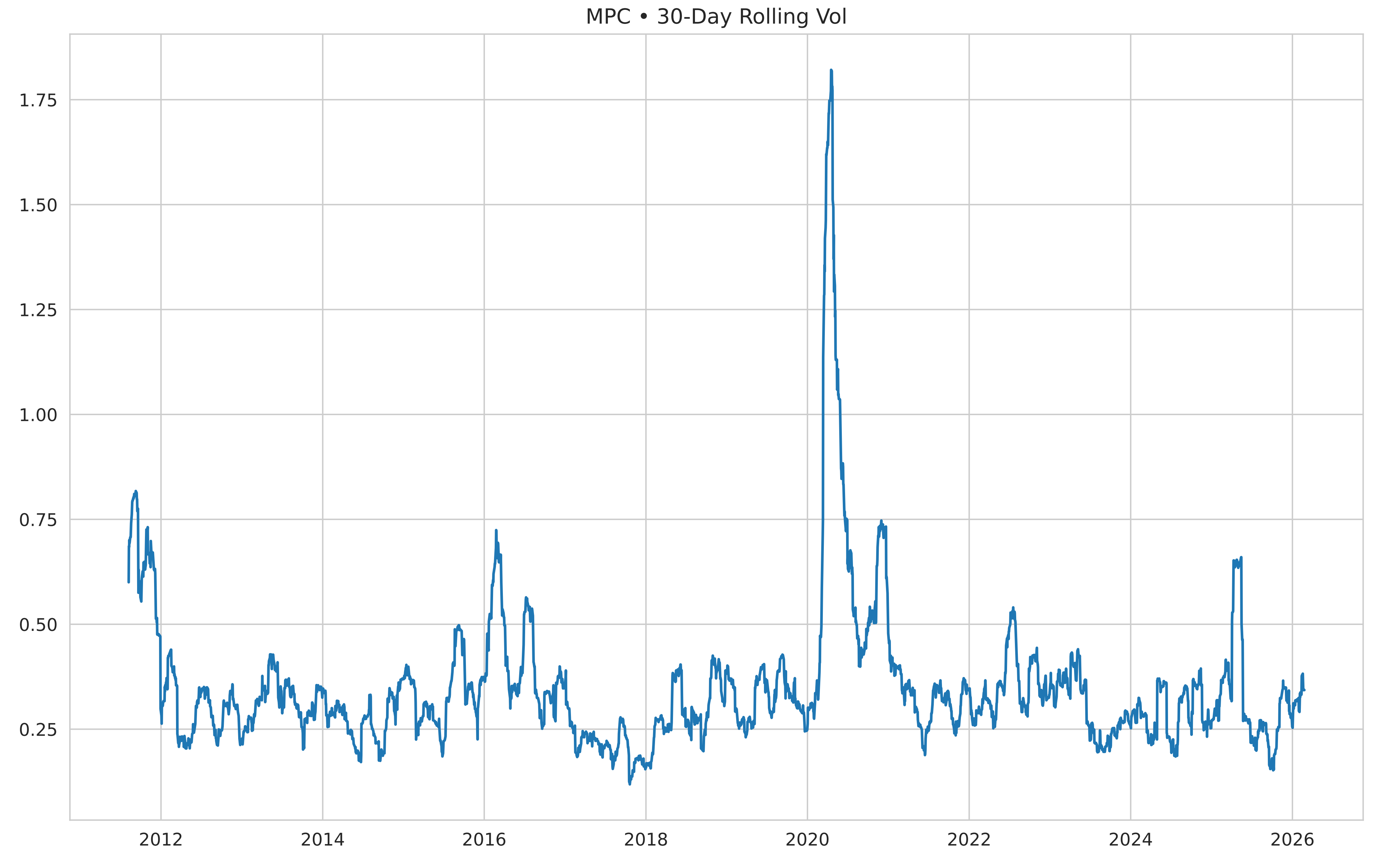
Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
Adj Close|MPC	3688	0.0	0	0	8.9315	11.0081	29.9422	42.1592	63.9283	83.9807	194.0244	210.0614	50.5957
Close|MPC	3688	0.0	0	0	13.53	16.5837	40.8063	53.93	73.1749	91.3825	197.0407	219.13	48.784
High|MPC	3688	0.0	0	0	13.9	16.92	41.5725	54.705	74.2224	93.085	199.6717	221.11	49.3884
Low|MPC	3688	0.0	0	0	13.175	16.1743	40.1138	53.215	72.1311	89.95	195.3065	217.63	48.192
Open|MPC	3688	0.0	0	0	13.4	16.665	40.8	53.875	73.1657	91.4975	196.8117	219.57	48.7773
Volume|MPC	3688	0.0	0	0	467171.0	1372883.0	3494850.0	5106800.0	5697213.7394	6979500.0	15947489.0	39153800.0	3082966.0955
month	3688	0.0	0	0	1.0	1.0	4.0	7.0	6.5952	10.0	12.0	12.0	3.4442
day_of_week	3688	0.0	690	0	0.0	0.0	1.0	2.0	2.0239	3.0	4.0	4.0	1.4003
quarter	3688	0.0	0	0	1.0	1.0	2.0	3.0	2.5334	4.0	4.0	4.0	1.1179
year	3688	0.0	0	0	2011.0	2011.0	2015.0	2018.0	2018.3023	2022.0	2025.0	2026.0	4.2442
s_month_end	3688	0.0	3564	0	0.0	0.0	0.0	0.0	0.0336	0.0	1.0	1.0	0.1803
s_month_start	3688	0.0	3576	0	0.0	0.0	0.0	0.0	0.0304	0.0	1.0	1.0	0.1716
_spread|MPC	3688	0.0	0	0	0.185	0.35	0.99	1.55	2.0912	2.68	7.9252	17.68	1.6572
C_spread|MPC	3688	0.0	17	1887	-15.79	-4.6626	-0.7	-0.03	-0.0092	0.645	4.86	12.77	1.5747
SMA_5|MPC	3688	0.0	0	0	9.2279	11.032	29.9212	41.9613	63.8297	84.2008	192.9263	206.9535	50.4971
EMA_5|MPC	3688	0.0	0	0	9.2721	11.0473	29.9562	42.0838	63.829	84.3293	192.4351	205.7565	50.4834
SMA_10|MPC	3688	0.0	0	0	9.5784	11.03	29.8942	41.7482	63.7039	83.6438	192.0265	204.1946	50.3676
EMA_10|MPC	3688	0.0	0	0	9.7025	11.0811	29.8821	41.8107	63.7043	83.8274	192.0987	201.8479	50.3452
SMA_20|MPC	3688	0.0	0	0	10.2862	11.1068	29.885	41.4892	63.4545	83.2406	191.3568	198.1295	50.1102
EMA_20|MPC	3688	0.0	0	0	10.3334	11.1172	29.878	41.5691	63.4642	83.0365	191.0626	196.1345	50.0947
lag_1|MPC	3687	0.03	0	0	8.9315	11.0079	29.9379	42.1434	63.8932	83.598	194.0251	210.0614	50.5577
lag_2|MPC	3686	0.05	0	0	8.9315	11.0076	29.9337	42.1289	63.8583	83.2496	194.0257	210.0614	50.5199
lag_3|MPC	3685	0.08	0	0	8.9315	11.0074	29.9294	42.1143	63.8222	83.2199	194.0076	210.0614	50.4793
tocorr_1|MPC	3688	0.0	0	0	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.0
tocorr_2|MPC	3688	0.0	0	0	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.0
tocorr_3|MPC	3688	0.0	0	0	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.0
log_ret|MPC	3687	0.03	8	1703	-0.3148	-0.0662	-0.0114	0.0017	0.0007	0.0134	0.0628	0.1875	0.0249
ag_ret_1|MPC	3686	0.05	8	1703	-0.3148	-0.0662	-0.0114	0.0017	0.0007	0.0134	0.0628	0.1875	0.0249
orr_ret_1|MPC	3688	0.0	0	3688	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.0
ag_ret_2|MPC	3685	0.08	8	1702	-0.3148	-0.0662	-0.0114	0.0017	0.0008	0.0134	0.0628	0.1875	0.0249
orr_ret_2|MPC	3688	0.0	0	0	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.0
ag_ret_3|MPC	3684	0.11	8	1702	-0.3148	-0.0663	-0.0114	0.0017	0.0008	0.0134	0.0628	0.1875	0.0249
orr_ret_3|MPC	3688	0.0	0	0	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0

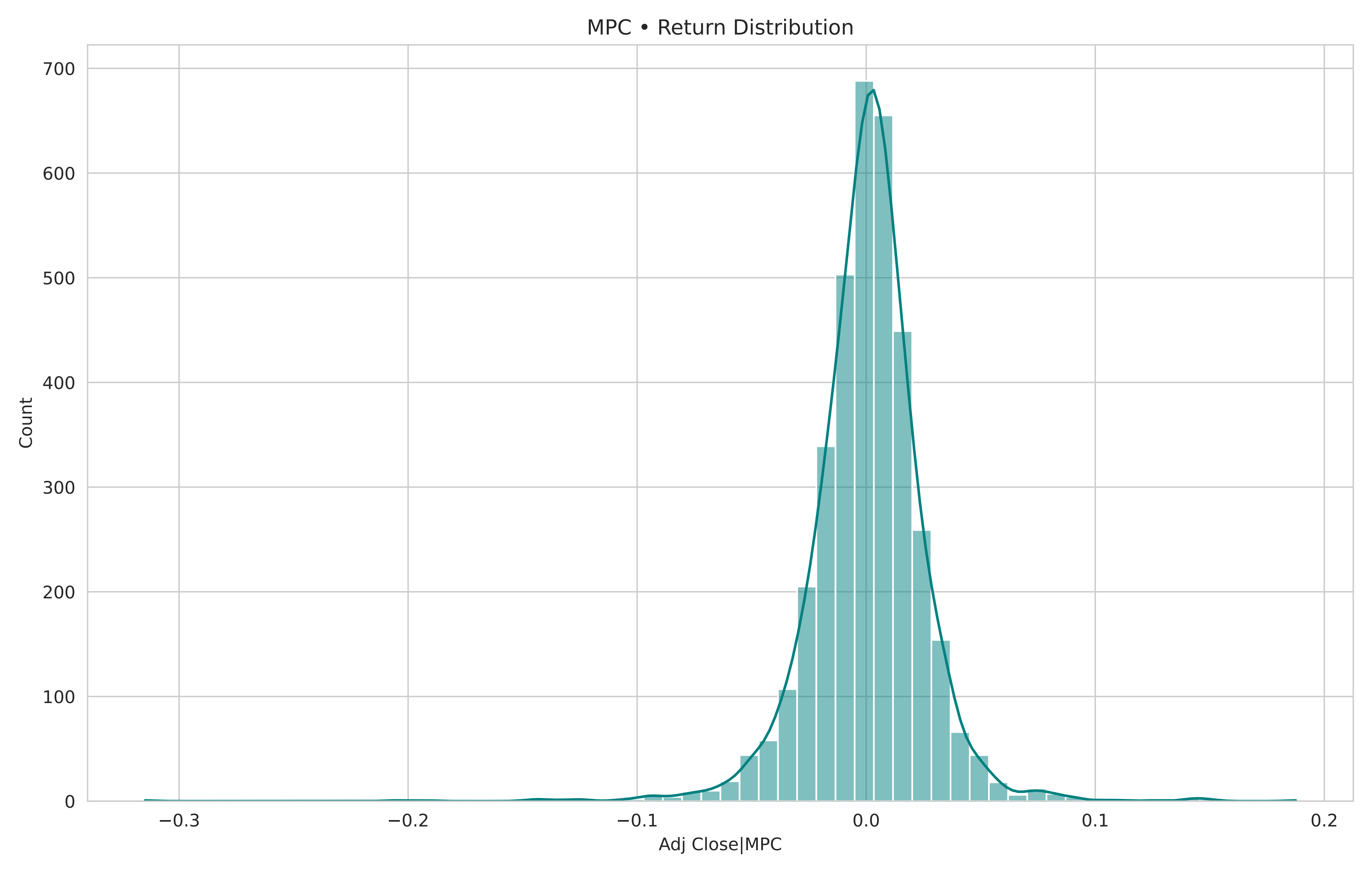
MPC • Describe

Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
Adj Close|MPC	3688.0	63.9283	50.5957	8.9315	11.0081	13.7511	29.9422	42.1592	83.9807	170.7817	194.0244	210.0614
Close|MPC	3688.0	73.1749	48.784	13.53	16.5837	20.2935	40.8063	53.93	91.3825	175.229	197.0407	219.13
High|MPC	3688.0	74.2224	49.3884	13.9	16.92	20.7403	41.5725	54.705	93.085	177.493	199.6717	221.11
Low|MPC	3688.0	72.1311	48.192	13.175	16.1743	19.9602	40.1138	53.215	89.95	172.886	195.3065	217.63
Open|MPC	3688.0	73.1657	48.7773	13.4	16.665	20.3917	40.8	53.875	91.4975	175.547	196.8117	219.57
Volume|MPC	3688.0	5597213.7393	4082966.0955	467171.0	1372883.0	1919465.0	3494850.0	5106800.0	6979500.0	10945780.0	15947489.0	39153800.0
month	3688.0	6.5952	3.4442	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3688.0	2.0239	1.4003	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3688.0	2.5334	1.1179	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3688.0	2018.3023	4.2442	2011.0	2011.0	2012.0	2015.0	2018.0	2022.0	2025.0	2025.0	2026.0
is_month_end	3688.0	0.0336	0.1803	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3688.0	0.0304	0.1716	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
IL_spread|MPC	3688.0	2.0912	1.6572	0.185	0.35	0.55	0.99	1.55	2.68	5.2865	7.9252	17.68
C_spread|MPC	3688.0	-0.0092	1.5747	-15.79	-4.6626	-2.26	-0.7	-0.03	0.645	2.2782	4.86	12.77
SMA_5|MPC	3688.0	63.8297	50.4971	9.2279	11.032	13.6214	29.9212	41.9613	84.2008	170.1065	192.9263	206.9535
EMA_5|MPC	3688.0	63.829	50.4834	9.2721	11.0473	13.5716	29.9562	42.0838	84.3293	170.0631	192.4351	205.7565
SMA_10|MPC	3688.0	63.7039	50.3676	9.5784	11.03	13.5023	29.8942	41.7482	83.6438	169.6861	192.0265	204.1946
EMA_10|MPC	3688.0	63.7043	50.3452	9.7025	11.0811	13.5394	29.8821	41.8107	83.8274	170.236	192.0987	201.8479
SMA_20|MPC	3688.0	63.4545	50.1102	10.2862	11.1068	13.3247	29.885	41.4892	83.2406	169.5973	191.3568	198.1295
EMA_20|MPC	3688.0	63.4642	50.0947	10.3334	11.1172	13.3532	29.878	41.5691	83.0365	170.4729	191.0626	196.1345
lag_1|MPC	3687.0	63.8932	50.5577	8.9315	11.0079	13.751	29.9379	42.1434	83.598	170.4999	194.0251	210.0614
lag_2|MPC	3686.0	63.8583	50.5199	8.9315	11.0076	13.7509	29.9337	42.1289	83.2496	170.4903	194.0257	210.0614
lag_3|MPC	3685.0	63.8222	50.4793	8.9315	11.0074	13.7508	29.9294	42.1143	83.2199	170.3915	194.0076	210.0614
utocorr_1|MPC	3688.0	0.9995	0.0	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995
utocorr_2|MPC	3688.0	0.9989	0.0	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989
utocorr_3|MPC	3688.0	0.9984	0.0	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984
log_ret|MPC	3687.0	0.0007	0.0249	-0.3148	-0.0662	-0.0368	-0.0114	0.0017	0.0134	0.0359	0.0628	0.1875
lag_ret_1|MPC	3686.0	0.0007	0.0249	-0.3148	-0.0662	-0.0368	-0.0114	0.0017	0.0134	0.0359	0.0628	0.1875
corr_ret_1|MPC	3688.0	-0.01	0.0	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
lag_ret_2|MPC	3685.0	0.0008	0.0249	-0.3148	-0.0662	-0.0368	-0.0114	0.0017	0.0134	0.0359	0.0628	0.1875
corr_ret_2|MPC	3688.0	0.048	0.0	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
lag_ret_3|MPC	3684.0	0.0008	0.0249	-0.3148	-0.0663	-0.0369	-0.0114	0.0017	0.0134	0.0359	0.0628	0.1875
corr_ret_3|MPC	3688.0	0.0284	0.0	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284


MPC • Correlation
Adj Close|MPC
Close|MPC
High|MPC
Low|MPC
Open|MPC
Volume|MPC
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|MPC
OC_spread|MPC
SMA_5|MPC
EMA_5|MPC
SMA_10|MPC
EMA_10|MPC
SMA_20|MPC
EMA_20|MPC
lag_1|MPC
lag_2|MPC
lag_3|MPC
autocorr_1|MPC
autocorr_2|MPC
autocorr_3|MPC
log_ret|MPC
lag_ret_1|MPC
autocorr_ret_1|MPC
lag_ret_2|MPC
autocorr_ret_2|MPC
lag_ret_3|MPC
autocorr_ret_3|MPC
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6


MPC • Price (Adj Close|MPC)
200
175
150
125
100
75
50
25
0
2012
2014
2016
2018
2020
2022
2024
2026


MPC • 30-Day Rolling Vol
1.75
1.50
1.25
1.00
0.75
0.50
0.25
2012
2014
2016
2018
2020
2022
2024
2026


MPC • Return Distribution
Count
Adj Close|MPC
0
100
200
300
400
500
600
700
−0.3
−0.2
−0.1
0.0
0.1
0.2

PSX • Schema & Missingness

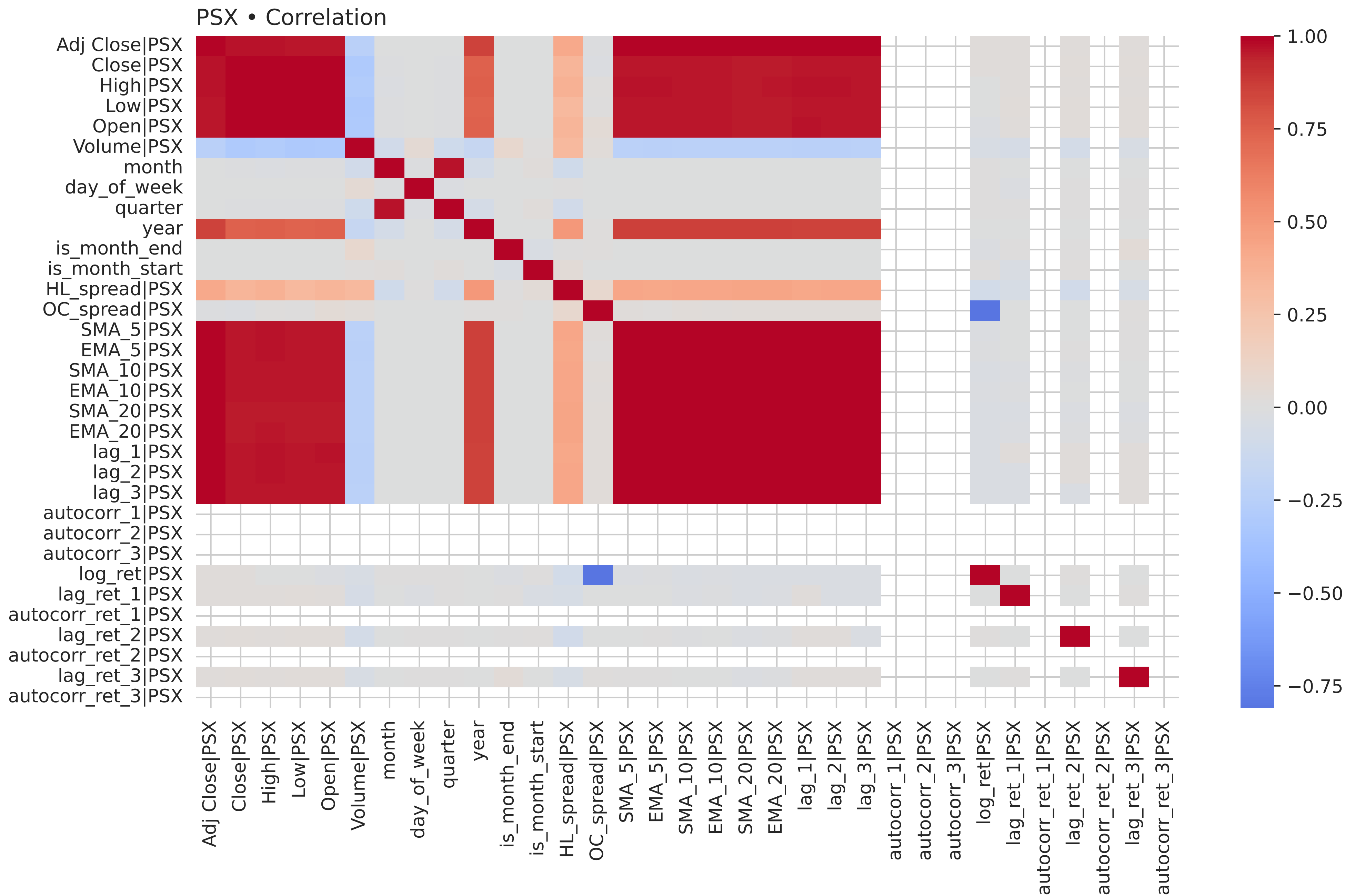
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|PSX	float64	3487	0	0.0	3385	21.4859
Close|PSX	float64	3487	0	0.0	2774	34.0
High|PSX	float64	3487	0	0.0	2815	34.21
Low|PSX	float64	3487	0	0.0	2768	32.0
Open|PSX	float64	3487	0	0.0	2727	33.25
Volume|PSX	int64	3487	0	0.0	3333	654700.0
month	int32	3487	0	0.0	12	4.0
day_of_week	int32	3487	0	0.0	5	3.0
quarter	int32	3487	0	0.0	4	2.0
year	int32	3487	0	0.0	15	2012.0
is_month_end	int64	3487	0	0.0	2	0.0
is_month_start	int64	3487	0	0.0	2	0.0
HL_spread|PSX	float64	3487	0	0.0	1691	2.21
OC_spread|PSX	float64	3487	0	0.0	1853	-0.75
SMA_5|PSX	float64	3487	0	0.0	3482	21.4859
EMA_5|PSX	float64	3487	0	0.0	3487	21.4859
SMA_10|PSX	float64	3487	0	0.0	3487	21.4859
EMA_10|PSX	float64	3487	0	0.0	3487	21.4859
SMA_20|PSX	float64	3487	0	0.0	3486	21.4859
EMA_20|PSX	float64	3487	0	0.0	3487	21.4859
lag_1|PSX	float64	3486	1	0.03	3384	21.4859
lag_2|PSX	float64	3485	2	0.06	3383	21.4859
lag_3|PSX	float64	3484	3	0.09	3382	21.4859
autocorr_1|PSX	float64	3487	0	0.0	1	0.9987
autocorr_2|PSX	float64	3487	0	0.0	1	0.9974
autocorr_3|PSX	float64	3487	0	0.0	1	0.996
log_ret|PSX	float64	3486	1	0.03	3471	0.0846
lag_ret_1|PSX	float64	3485	2	0.06	3470	0.0846
autocorr_ret_1|PSX	float64	3487	0	0.0	1	-0.0074
lag_ret_2|PSX	float64	3484	3	0.09	3469	0.0846
autocorr_ret_2|PSX	float64	3487	0	0.0	1	0.0142
lag_ret_3|PSX	float64	3483	4	0.11	3468	0.0846
autocorr_ret_3|PSX	float64	3487	0	0.0	1	-0.0073

PSX • Numeric Quality

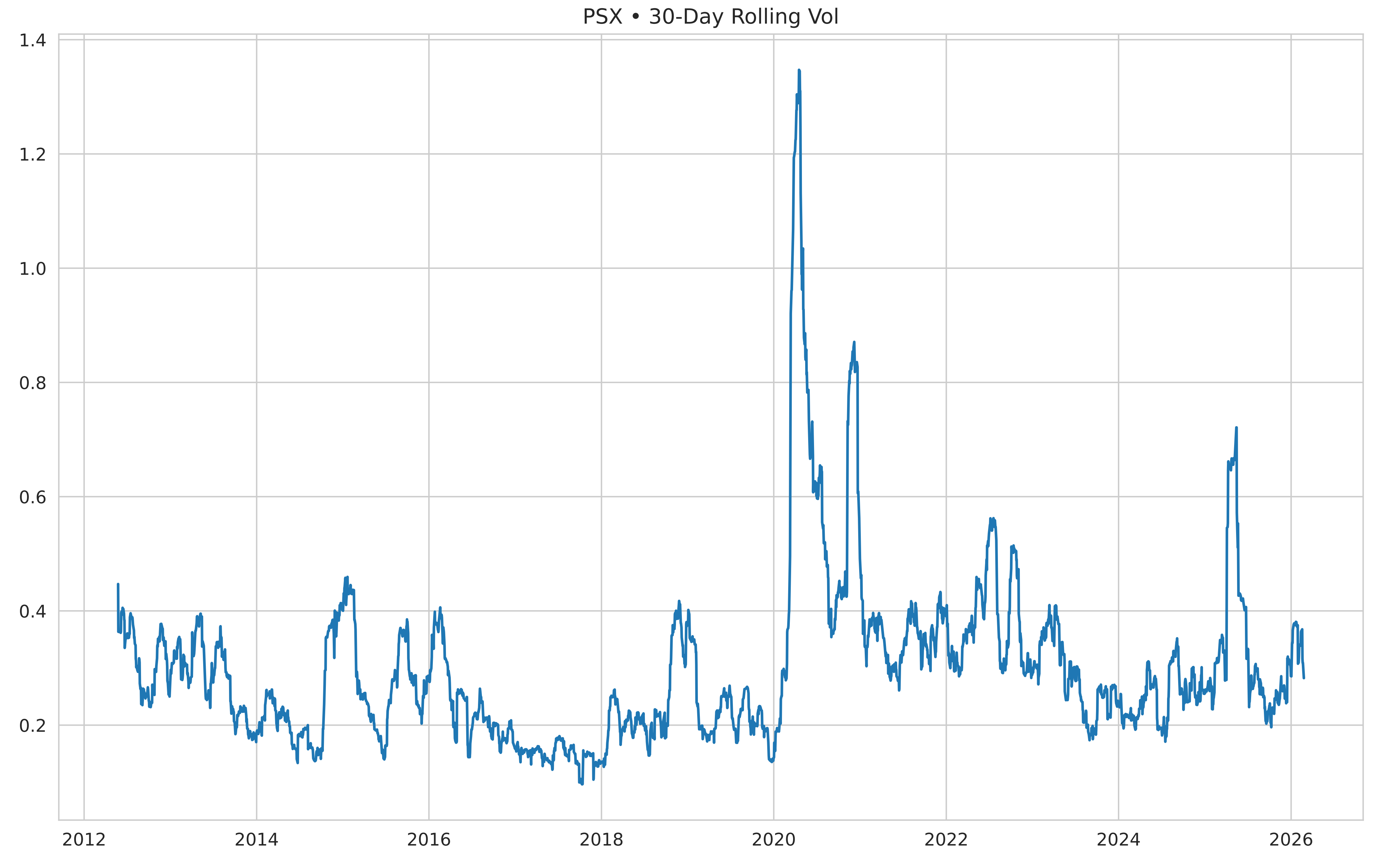
Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
Adj Close|PSX	3487	0.0	0	0	18.5474	20.8479	53.528	65.4601	72.839	88.0686	147.854	162.3481	30.006
Close|PSX	3487	0.0	0	0	29.35	32.9904	75.93	84.8	90.105	105.585	155.8214	172.71	25.8968
High|PSX	3487	0.0	0	0	30.1	33.64	76.92	85.75	91.2255	106.73	157.7294	174.08	26.125
Low|PSX	3487	0.0	0	0	28.75	32.4986	74.83	83.8	88.9966	103.91	154.0308	170.64	25.6933
Open|PSX	3487	0.0	0	0	29.09	33.0758	75.895	84.85	90.1115	105.37	155.1098	173.18	25.9139
Volume|PSX	3487	0.0	0	0	95700.0	1144998.0	2276150.0	2894200.0	3237906.4396	3779400.0	8890096.0	16579800.0	1642343.9077
month	3487	0.0	0	0	1.0	1.0	4.0	7.0	6.5767	10.0	12.0	12.0	3.4261
day_of_week	3487	0.0	654	0	0.0	0.0	1.0	2.0	2.0229	3.0	4.0	4.0	1.4008
quarter	3487	0.0	0	0	1.0	1.0	2.0	3.0	2.5274	4.0	4.0	4.0	1.1118
year	3487	0.0	0	0	2012.0	2012.0	2015.0	2019.0	2018.7035	2022.0	2026.0	2026.0	4.0106
s_month_end	3487	0.0	3370	0	0.0	0.0	0.0	0.0	0.0336	0.0	1.0	1.0	0.1801
s_month_start	3487	0.0	3382	0	0.0	0.0	0.0	0.0	0.0301	0.0	1.0	1.0	0.1709
L_spread|PSX	3487	0.0	0	0	0.41	0.61	1.36	1.95	2.2289	2.78	6.3828	14.8	1.2495
C_spread|PSX	3487	0.0	11	1760	-11.53	-3.8714	-0.8	-0.02	0.0065	0.75	4.1942	10.28	1.506
SMA_5|PSX	3487	0.0	0	0	18.9354	20.9518	53.4538	65.3857	72.7631	87.806	147.4306	160.2105	29.9347
EMA_5|PSX	3487	0.0	0	0	18.9895	20.9935	53.5406	65.4997	72.7624	87.8347	147.8629	158.8165	29.9172
SMA_10|PSX	3487	0.0	0	0	19.3499	21.0154	53.5203	65.4228	72.6668	87.8669	146.7992	157.686	29.8436
EMA_10|PSX	3487	0.0	0	0	19.2564	20.9389	53.6074	65.3719	72.6665	87.7468	146.7703	156.1105	29.8129
SMA_20|PSX	3487	0.0	0	0	19.6713	21.0395	53.5607	65.3512	72.4761	87.5916	145.1826	153.3423	29.6666
EMA_20|PSX	3487	0.0	0	0	19.6672	20.7952	53.6795	65.5961	72.4818	87.5811	144.7899	152.6163	29.6284
lag_1|PSX	3486	0.03	0	0	18.5474	20.847	53.527	65.449	72.8159	88.0509	147.8076	162.3481	29.9792
lag_2|PSX	3485	0.06	0	0	18.5474	20.8461	53.5261	65.4379	72.7924	88.0157	147.6562	162.3481	29.9513
lag_3|PSX	3484	0.09	0	0	18.5474	20.8452	53.5254	65.4326	72.7686	87.9977	147.5808	162.3481	29.9226
utocorr_1|PSX	3487	0.0	0	0	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.0
utocorr_2|PSX	3487	0.0	0	0	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	0.0
utocorr_3|PSX	3487	0.0	0	0	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.0
og_ret|PSX	3486	0.03	16	1638	-0.1728	-0.0596	-0.0093	0.0009	0.0006	0.011	0.0532	0.2003	0.0211
lag_ret_1|PSX	3485	0.06	16	1637	-0.1728	-0.0596	-0.0093	0.0009	0.0006	0.0111	0.0532	0.2003	0.0211
orr_ret_1|PSX	3487	0.0	0	3487	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	0.0
lag_ret_2|PSX	3484	0.09	16	1636	-0.1728	-0.0596	-0.0093	0.0009	0.0006	0.0111	0.0532	0.2003	0.0211
orr_ret_2|PSX	3487	0.0	0	0	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0
lag_ret_3|PSX	3483	0.11	16	1636	-0.1728	-0.0596	-0.0093	0.0009	0.0006	0.0111	0.0532	0.2003	0.0211
orr_ret_3|PSX	3487	0.0	0	3487	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	0.0

PSX • Describe

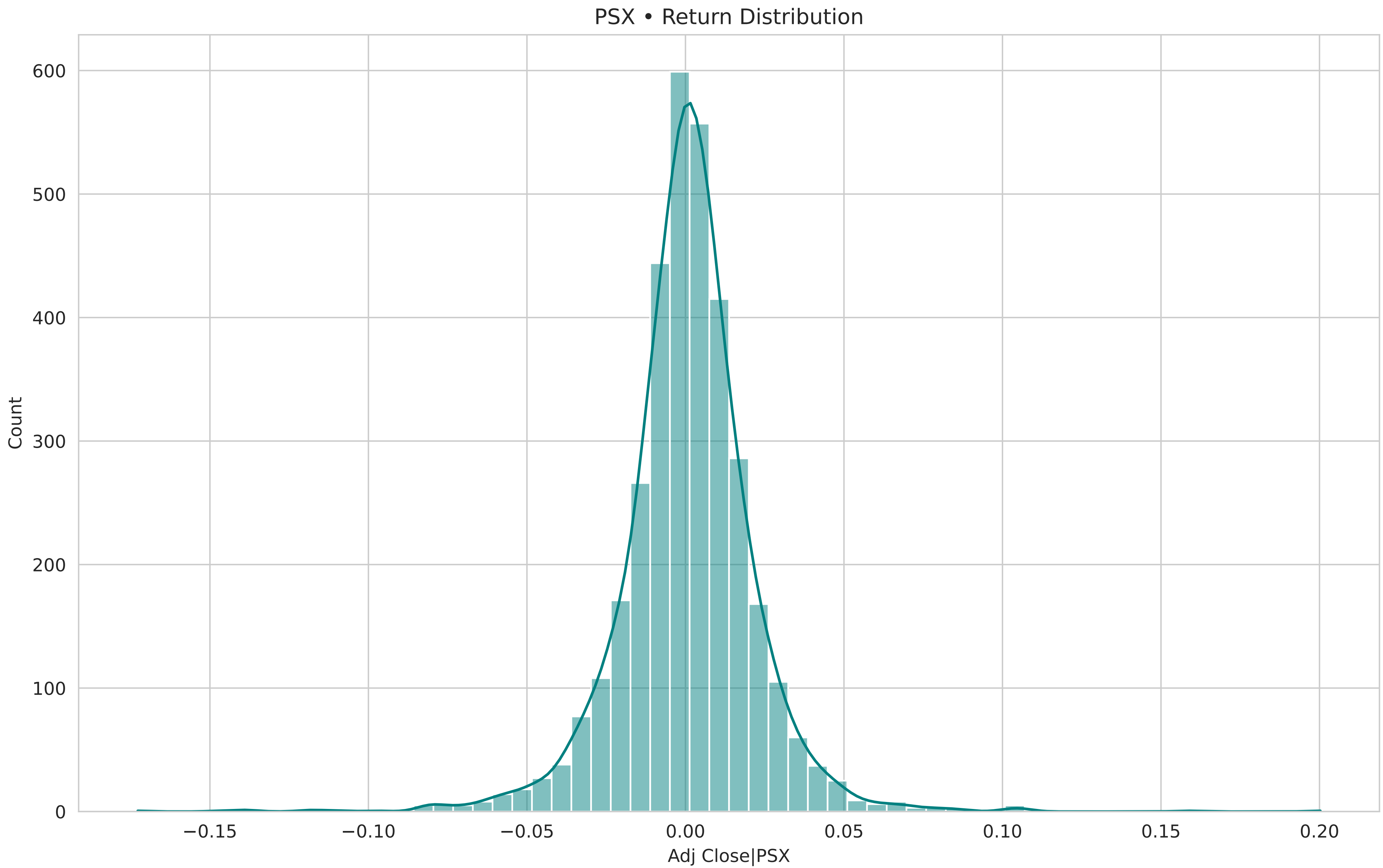
Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
Adj Close|PSX	3487.0	72.839	30.006	18.5474	20.8479	33.2401	53.528	65.4601	88.0686	132.7124	147.854	162.3481
Close|PSX	3487.0	90.105	25.8968	29.35	32.9904	49.525	75.93	84.8	105.585	137.988	155.8214	172.71
High|PSX	3487.0	91.2255	26.125	30.1	33.64	50.79	76.92	85.75	106.73	139.564	157.7294	174.08
Low|PSX	3487.0	88.9966	25.6933	28.75	32.4986	48.708	74.83	83.8	103.91	136.12	154.0308	170.64
Open|PSX	3487.0	90.1115	25.9139	29.09	33.0758	49.349	75.895	84.85	105.37	137.767	155.1098	173.18
Volume|PSX	3487.0	3237906.4396	1542343.9077	95700.0	1144998.0	1602560.0	2276150.0	2894200.0	3779400.0	6012100.0	8890096.0	16579800.0
month	3487.0	6.5767	3.4261	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3487.0	2.0229	1.4008	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3487.0	2.5274	1.1118	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3487.0	2018.7035	4.0106	2012.0	2012.0	2012.0	2015.0	2019.0	2022.0	2025.0	2026.0	2026.0
is_month_end	3487.0	0.0336	0.1801	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3487.0	0.0301	0.1709	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
HL_spread|PSX	3487.0	2.2289	1.2495	0.41	0.61	0.83	1.36	1.95	2.78	4.607	6.3828	14.8
C_spread|PSX	3487.0	0.0065	1.506	-11.53	-3.8714	-2.327	-0.8	-0.02	0.75	2.527	4.1942	10.28
SMA_5|PSX	3487.0	72.7631	29.9347	18.9354	20.9518	33.2564	53.4538	65.3857	87.806	132.4755	147.4306	160.2105
EMA_5|PSX	3487.0	72.7624	29.9172	18.9895	20.9935	33.2699	53.5406	65.4997	87.8347	132.4594	147.8629	158.8165
SMA_10|PSX	3487.0	72.6668	29.8436	19.3499	21.0154	33.3771	53.5203	65.4228	87.8669	132.2934	146.7992	157.686
EMA_10|PSX	3487.0	72.6665	29.8129	19.2564	20.9389	33.2557	53.6074	65.3719	87.7468	132.3364	146.7703	156.1105
SMA_20|PSX	3487.0	72.4761	29.6666	19.6713	21.0395	33.1957	53.5607	65.3512	87.5916	131.8113	145.1826	153.3423
EMA_20|PSX	3487.0	72.4818	29.6284	19.6672	20.7952	32.9972	53.6795	65.5961	87.5811	132.241	144.7899	152.6163
lag_1|PSX	3486.0	72.8159	29.9792	18.5474	20.847	33.234	53.527	65.449	88.0509	132.7017	147.8076	162.3481
lag_2|PSX	3485.0	72.7924	29.9513	18.5474	20.8461	33.2279	53.5261	65.4379	88.0157	132.6443	147.6562	162.3481
lag_3|PSX	3484.0	72.7686	29.9226	18.5474	20.8452	33.2219	53.5254	65.4326	87.9977	132.5211	147.5808	162.3481
utocorr_1|PSX	3487.0	0.9987	0.0	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987	0.9987
utocorr_2|PSX	3487.0	0.9974	0.0	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974	0.9974
utocorr_3|PSX	3487.0	0.996	0.0	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
log_ret|PSX	3486.0	0.0006	0.0211	-0.1728	-0.0596	-0.0323	-0.0093	0.0009	0.011	0.0315	0.0532	0.2003
lag_ret_1|PSX	3485.0	0.0006	0.0211	-0.1728	-0.0596	-0.0323	-0.0093	0.0009	0.0111	0.0315	0.0532	0.2003
corr_ret_1|PSX	3487.0	-0.0074	0.0	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074	-0.0074
lag_ret_2|PSX	3484.0	0.0006	0.0211	-0.1728	-0.0596	-0.0323	-0.0093	0.0009	0.0111	0.0315	0.0532	0.2003
corr_ret_2|PSX	3487.0	0.0142	0.0	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142
lag_ret_3|PSX	3483.0	0.0006	0.0211	-0.1728	-0.0596	-0.0323	-0.0093	0.0009	0.0111	0.0315	0.0532	0.2003
corr_ret_3|PSX	3487.0	-0.0073	0.0	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073	-0.0073


PSX • Correlation
Adj Close|PSX
Close|PSX
High|PSX
Low|PSX
Open|PSX
Volume|PSX
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|PSX
OC_spread|PSX
SMA_5|PSX
EMA_5|PSX
SMA_10|PSX
EMA_10|PSX
SMA_20|PSX
EMA_20|PSX
lag_1|PSX
lag_2|PSX
lag_3|PSX
autocorr_1|PSX
autocorr_2|PSX
autocorr_3|PSX
log_ret|PSX
lag_ret_1|PSX
autocorr_ret_1|PSX
lag_ret_2|PSX
autocorr_ret_2|PSX
lag_ret_3|PSX
autocorr_ret_3|PSX
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75


PSX • Price (Adj Close|PSX)
160
140
120
100
80
60
40
20
2012
2014
2016
2018
2020
2022
2024
2026



PSX • 30-Day Rolling Vol
1.4
1.2
1.0
0.8
0.6
0.4
0.2
2012
2014
2016
2018
2020
2022
2024
2026


PSX • Return Distribution
Count
Adj Close|PSX
0
100
200
300
400
500
600
−0.15
−0.10
−0.05
0.00
0.05
0.10
0.15
0.20

VLO • Schema & Missingness

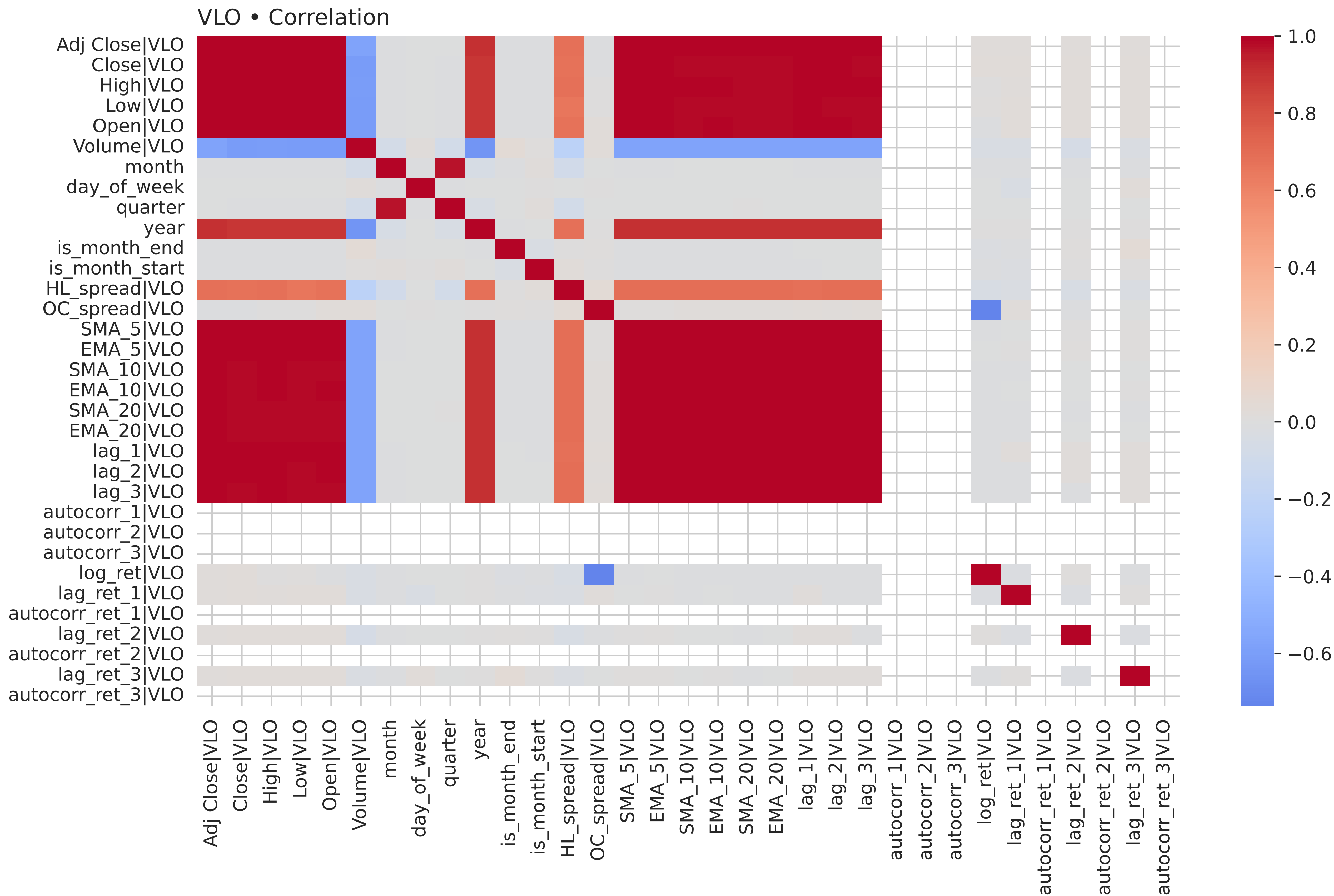
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|VLO	float64	3770	0	0.0	3684	15.468
Close|VLO	float64	3770	0	0.0	3258	25.7587
High|VLO	float64	3770	0	0.0	3244	26.3894
Low|VLO	float64	3770	0	0.0	3209	25.457
Open|VLO	float64	3770	0	0.0	3212	26.2614
Volume|VLO	int64	3770	0	0.0	3700	12430356.0
month	int32	3770	0	0.0	12	2.0
day_of_week	int32	3770	0	0.0	5	0.0
quarter	int32	3770	0	0.0	4	1.0
year	int32	3770	0	0.0	16	2011.0
is_month_end	int64	3770	0	0.0	2	1.0
is_month_start	int64	3770	0	0.0	2	0.0
HL_spread|VLO	float64	3770	0	0.0	2296	0.9324
OC_spread|VLO	float64	3770	0	0.0	2544	0.5027
SMA_5|VLO	float64	3770	0	0.0	3759	15.468
EMA_5|VLO	float64	3770	0	0.0	3770	15.468
SMA_10|VLO	float64	3770	0	0.0	3767	15.468
EMA_10|VLO	float64	3770	0	0.0	3770	15.468
SMA_20|VLO	float64	3770	0	0.0	3770	15.468
EMA_20|VLO	float64	3770	0	0.0	3770	15.468
lag_1|VLO	float64	3769	1	0.03	3683	15.468
lag_2|VLO	float64	3768	2	0.05	3682	15.468
lag_3|VLO	float64	3767	3	0.08	3681	15.468
autocorr_1|VLO	float64	3770	0	0.0	1	0.9992
autocorr_2|VLO	float64	3770	0	0.0	1	0.9984
autocorr_3|VLO	float64	3770	0	0.0	1	0.9976
log_ret|VLO	float64	3769	1	0.03	3758	-0.0435
lag_ret_1|VLO	float64	3768	2	0.05	3757	-0.0435
autocorr_ret_1|VLO	float64	3770	0	0.0	1	-0.021
lag_ret_2|VLO	float64	3767	3	0.08	3756	-0.0435
autocorr_ret_2|VLO	float64	3770	0	0.0	1	0.0146
lag_ret_3|VLO	float64	3766	4	0.11	3755	-0.0435
autocorr_ret_3|VLO	float64	3770	0	0.0	1	-0.0109

VLO • Numeric Quality

Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
Adj Close|VLO	3770	0.0	0	0	9.465	11.4698	33.9065	52.9884	65.6371	94.8766	178.2401	203.92	43.1499
Close|VLO	3770	0.0	0	0	15.6947	18.9277	50.8225	68.7	79.7432	112.99	180.5493	203.92	41.101
High|VLO	3770	0.0	0	0	16.4168	19.2385	51.4925	69.845	80.9155	114.845	183.2282	206.77	41.6739
Low|VLO	3770	0.0	0	0	14.9909	18.5473	50.03	68.07	78.5583	111.0075	177.5813	200.51	40.531
Open|VLO	3770	0.0	0	0	15.3748	18.9016	50.79	68.795	79.7527	113.19	180.2898	204.08	41.112
Volume|VLO	3770	0.0	0	0	559800.0	1657225.0	3172525.0	4507200.0	5629390.8308	7077025.0	17986118.964	44023700.0	3536204.5631
month	3770	0.0	0	0	1.0	1.0	4.0	7.0	6.5467	10.0	12.0	12.0	3.4261
day_of_week	3770	0.0	706	0	0.0	0.0	1.0	2.0	2.0228	3.0	4.0	4.0	1.4001
quarter	3770	0.0	0	0	1.0	1.0	2.0	3.0	2.5154	4.0	4.0	4.0	1.1143
year	3770	0.0	0	0	2011.0	2011.0	2014.0	2018.0	2018.1435	2022.0	2025.0	2026.0	4.3308
s_month_end	3770	0.0	3643	0	0.0	0.0	0.0	0.0	0.0337	0.0	1.0	1.0	0.1804
s_month_start	3770	0.0	3655	0	0.0	0.0	0.0	0.0	0.0305	0.0	1.0	1.0	0.172
L_spread|VLO	3770	0.0	0	0	0.2468	0.436	1.13	1.875	2.3572	3.1	8.2631	15.73	1.7047
C_spread|VLO	3770	0.0	17	1938	-12.12	-4.92	-0.73	-0.04	0.0095	0.73	5.3	12.12	1.7183
SMA_5|VLO	3770	0.0	0	0	9.9192	11.4196	34.065	53.187	65.54	94.6807	176.4208	200.878	43.0289
EMA_5|VLO	3770	0.0	0	0	9.9462	11.4877	34.0633	53.3718	65.54	95.0989	176.0845	199.7364	43.0139
SMA_10|VLO	3770	0.0	0	0	10.1998	11.4837	34.0053	53.3577	65.4181	94.9646	175.3144	200.136	42.8799
EMA_10|VLO	3770	0.0	0	0	10.3067	11.5754	34.0346	53.0589	65.4193	95.389	175.0414	198.1059	42.8519
SMA_20|VLO	3770	0.0	0	0	10.934	11.627	34.05	52.6131	65.1769	95.6983	173.4184	194.1567	42.5865
EMA_20|VLO	3770	0.0	0	0	10.8222	11.7541	34.0473	52.3789	65.1856	97.0383	173.3792	194.6073	42.5531
lag_1|VLO	3769	0.03	0	0	9.465	11.4694	33.9028	52.9585	65.6021	94.8566	177.6579	203.92	43.1022
lag_2|VLO	3768	0.05	0	0	9.465	11.4691	33.8999	52.9295	65.5671	94.8365	177.2716	203.92	43.0544
lag_3|VLO	3767	0.08	0	0	9.465	11.4688	33.897	52.9004	65.5312	94.7406	177.0468	203.92	43.0037
utocorr_1|VLO	3770	0.0	0	0	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.0
utocorr_2|VLO	3770	0.0	0	0	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.0
utocorr_3|VLO	3770	0.0	0	0	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.0
log_ret|VLO	3769	0.03	11	1787	-0.2135	-0.0655	-0.0113	0.001	0.0007	0.0133	0.061	0.2716	0.0245
lag_ret_1|VLO	3768	0.05	11	1787	-0.2135	-0.0655	-0.0113	0.001	0.0007	0.0133	0.061	0.2716	0.0245
orr_ret_1|VLO	3770	0.0	0	3770	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	0.0
lag_ret_2|VLO	3767	0.08	11	1786	-0.2135	-0.0656	-0.0113	0.001	0.0007	0.0133	0.061	0.2716	0.0245
orr_ret_2|VLO	3770	0.0	0	0	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146	0.0
lag_ret_3|VLO	3766	0.11	11	1786	-0.2135	-0.0656	-0.0113	0.001	0.0007	0.0133	0.061	0.2716	0.0245
orr_ret_3|VLO	3770	0.0	0	3770	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	0.0

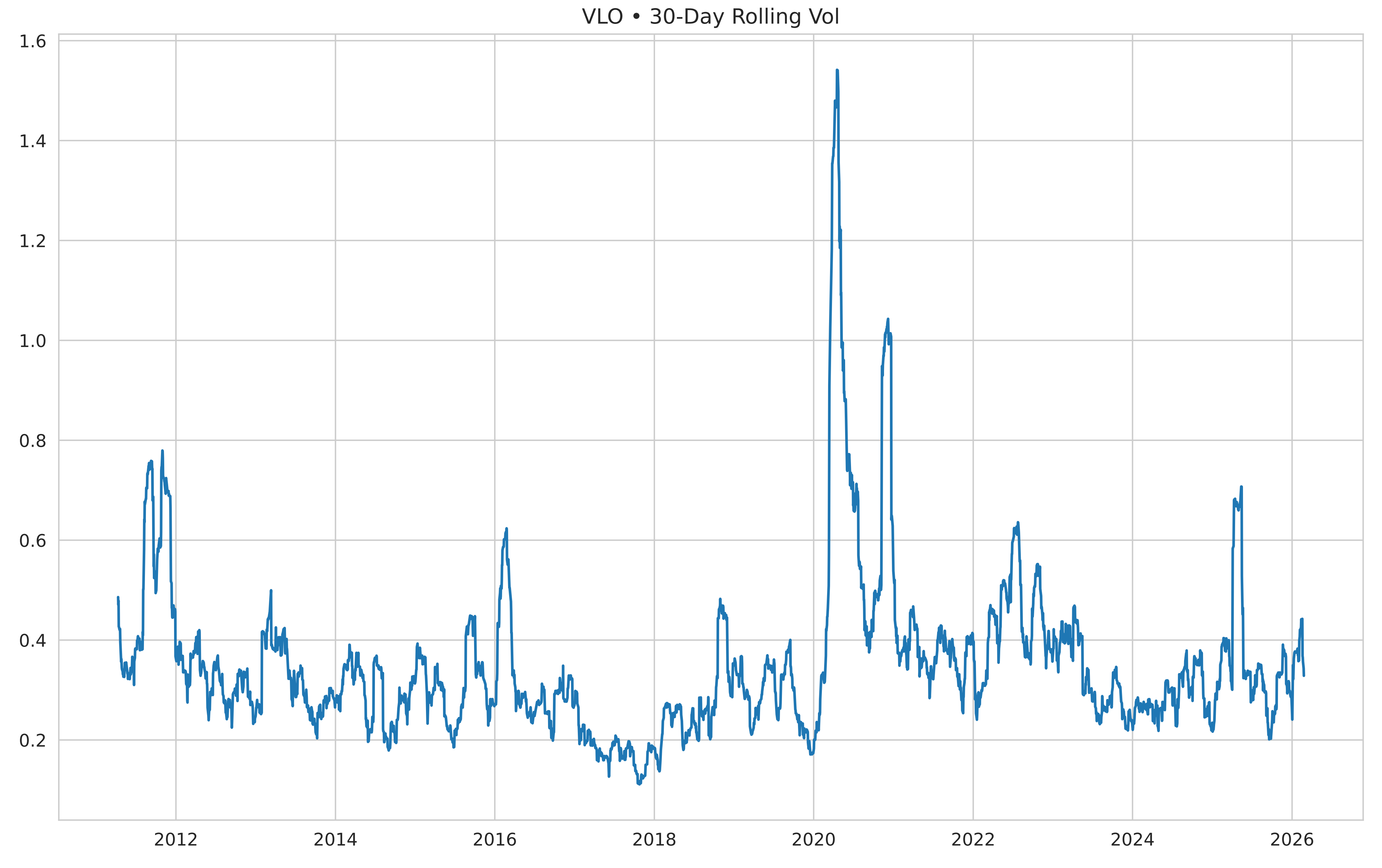
VLO • Describe

Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
Adj Close|VLO	3770.0	65.6371	43.1499	9.465	11.4698	13.6677	33.9065	52.9884	94.8766	147.217	178.2401	203.92
Close|VLO	3770.0	79.7432	41.101	15.6947	18.9277	22.5087	50.8225	68.7	112.99	154.518	180.5493	203.92
High|VLO	3770.0	80.9155	41.6739	16.4168	19.2385	22.8885	51.4925	69.845	114.845	156.527	183.2282	206.77
Low|VLO	3770.0	78.5583	40.531	14.9909	18.5473	22.0699	50.03	68.07	111.0075	152.2165	177.5813	200.51
Open|VLO	3770.0	79.7527	41.112	15.3748	18.9016	22.5137	50.79	68.795	113.19	154.227	180.2898	204.08
Volume|VLO	3770.0	5629390.8308	3536204.5631	559800.0	1657225.0	2148205.0	3172525.0	4507200.0	7077025.0	12468915.25	17986118.96	44023700.0
month	3770.0	6.5467	3.4261	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3770.0	2.0228	1.4001	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3770.0	2.5154	1.1143	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3770.0	2018.1435	4.3308	2011.0	2011.0	2011.0	2014.0	2018.0	2022.0	2025.0	2025.0	2026.0
is_month_end	3770.0	0.0337	0.1804	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3770.0	0.0305	0.172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
HL_spread|VLO	3770.0	2.3572	1.7047	0.2468	0.436	0.6	1.13	1.875	3.1	5.6155	8.2631	15.73
OC_spread|VLO	3770.0	0.0095	1.7183	-12.12	-4.92	-2.6055	-0.73	-0.04	0.73	2.8	5.3	12.12
SMA_5|VLO	3770.0	65.54	43.0289	9.9192	11.4196	13.6544	34.065	53.187	94.6807	147.3834	176.4208	200.878
EMA_5|VLO	3770.0	65.54	43.0139	9.9462	11.4877	13.6617	34.0633	53.3718	95.0989	147.286	176.0845	199.7364
SMA_10|VLO	3770.0	65.4181	42.8799	10.1998	11.4837	13.6154	34.0053	53.3577	94.9646	146.3936	175.3144	200.136
EMA_10|VLO	3770.0	65.4193	42.8519	10.3067	11.5754	13.6349	34.0346	53.0589	95.389	146.2715	175.0414	198.1059
SMA_20|VLO	3770.0	65.1769	42.5865	10.934	11.627	13.6239	34.05	52.6131	95.6983	145.0044	173.4184	194.1567
EMA_20|VLO	3770.0	65.1856	42.5531	10.8222	11.7541	13.6077	34.0473	52.3789	97.0383	145.9645	173.3792	194.6073
lag_1|VLO	3769.0	65.6021	43.1022	9.465	11.4694	13.6674	33.9028	52.9585	94.8566	147.1132	177.6579	203.92
lag_2|VLO	3768.0	65.5671	43.0544	9.465	11.4691	13.6671	33.8999	52.9295	94.8365	147.034	177.2716	203.92
lag_3|VLO	3767.0	65.5312	43.0037	9.465	11.4688	13.6668	33.897	52.9004	94.7406	146.8784	177.0468	203.92
autocorr_1|VLO	3770.0	0.9992	0.0	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992
autocorr_2|VLO	3770.0	0.9984	0.0	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984	0.9984
autocorr_3|VLO	3770.0	0.9976	0.0	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976	0.9976
log_ret|VLO	3769.0	0.0007	0.0245	-0.2135	-0.0655	-0.037	-0.0113	0.001	0.0133	0.0366	0.061	0.2716
lag_ret_1|VLO	3768.0	0.0007	0.0245	-0.2135	-0.0655	-0.037	-0.0113	0.001	0.0133	0.0366	0.061	0.2716
corr_ret_1|VLO	3770.0	-0.021	0.0	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021
lag_ret_2|VLO	3767.0	0.0007	0.0245	-0.2135	-0.0656	-0.037	-0.0113	0.001	0.0133	0.0366	0.061	0.2716
corr_ret_2|VLO	3770.0	0.0146	0.0	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146	0.0146
lag_ret_3|VLO	3766.0	0.0007	0.0245	-0.2135	-0.0656	-0.037	-0.0113	0.001	0.0133	0.0366	0.061	0.2716
corr_ret_3|VLO	3770.0	-0.0109	0.0	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109	-0.0109

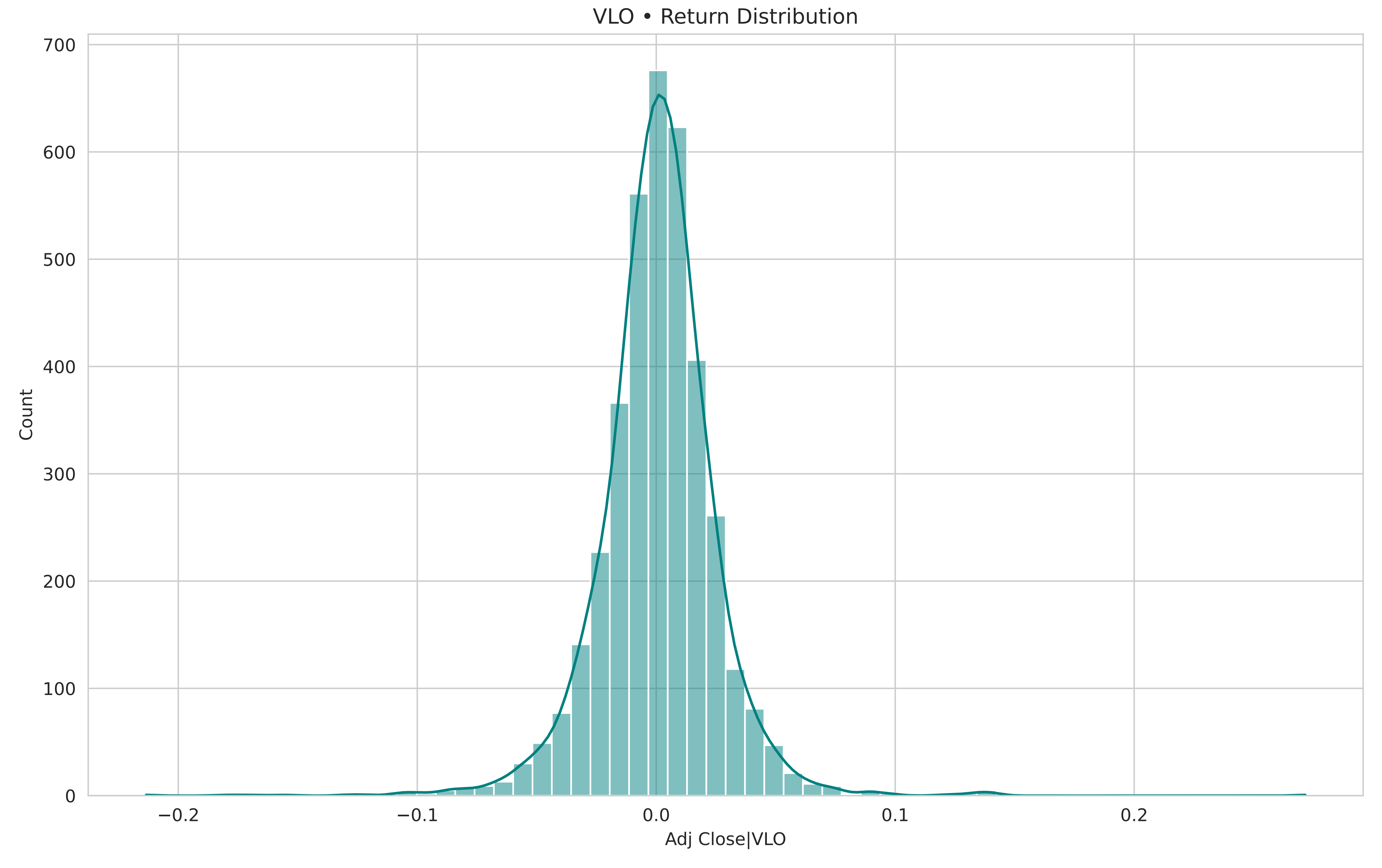


VLO • Correlation
Adj Close|VLO
Close|VLO
High|VLO
Low|VLO
Open|VLO
Volume|VLO
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|VLO
OC_spread|VLO
SMA_5|VLO
EMA_5|VLO
SMA_10|VLO
EMA_10|VLO
SMA_20|VLO
EMA_20|VLO
lag_1|VLO
lag_2|VLO
lag_3|VLO
autocorr_1|VLO
autocorr_2|VLO
autocorr_3|VLO
log_ret|VLO
lag_ret_1|VLO
autocorr_ret_1|VLO
lag_ret_2|VLO
autocorr_ret_2|VLO
lag_ret_3|VLO
autocorr_ret_3|VLO
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6


VLO • Price (Adj Close|VLO)
200
175
150
125
100
75
50
25
0
2012
2014
2016
2018
2020
2022
2024
2026



VLO • 30-Day Rolling Vol
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
2012
2014
2016
2018
2020
2022
2024
2026


VLO • Return Distribution
Count
Adj Close|VLO
0
100
200
300
400
500
600
700
−0.2
−0.1
0.0
0.1
0.2

^GSPC • Schema & Missingness

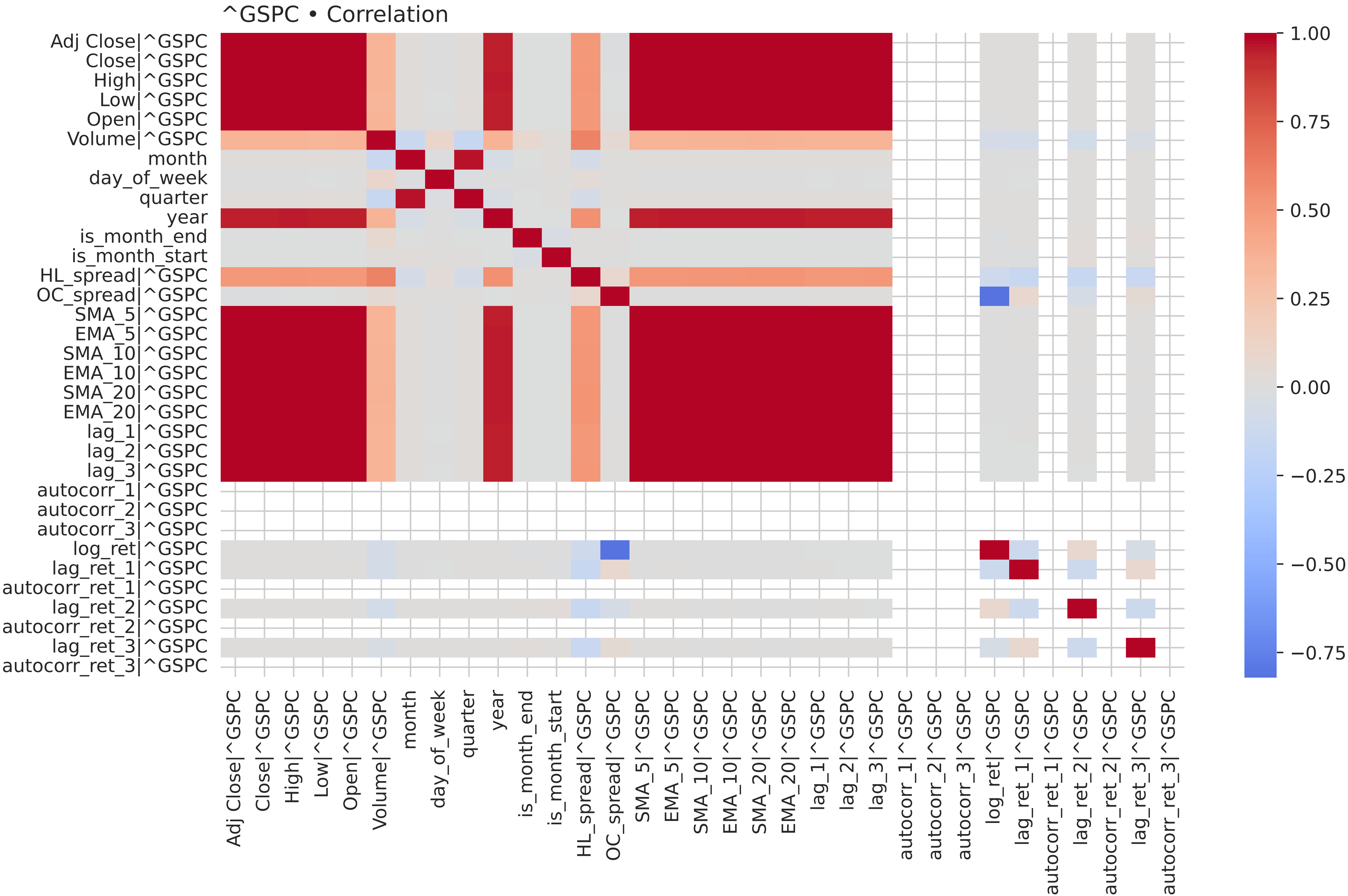
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|^GSPC	float64	3770	0	0.0	3756	1327.22
Close|^GSPC	float64	3770	0	0.0	3756	1327.22
High|^GSPC	float64	3770	0	0.0	3743	1329.38
Low|^GSPC	float64	3770	0	0.0	3751	1320.55
Open|^GSPC	float64	3770	0	0.0	3746	1321.61
Volume|^GSPC	int64	3770	0	0.0	3722	1252850000.0
month	int32	3770	0	0.0	12	2.0
day_of_week	int32	3770	0	0.0	5	0.0
quarter	int32	3770	0	0.0	4	1.0
year	int32	3770	0	0.0	16	2011.0
is_month_end	int64	3770	0	0.0	2	1.0
is_month_start	int64	3770	0	0.0	2	0.0
HL_spread|^GSPC	float64	3770	0	0.0	3312	8.83
OC_spread|^GSPC	float64	3770	0	0.0	3414	-5.61
SMA_5|^GSPC	float64	3770	0	0.0	3765	1327.22
EMA_5|^GSPC	float64	3770	0	0.0	3770	1327.22
SMA_10|^GSPC	float64	3770	0	0.0	3770	1327.22
EMA_10|^GSPC	float64	3770	0	0.0	3770	1327.22
SMA_20|^GSPC	float64	3770	0	0.0	3769	1327.22
EMA_20|^GSPC	float64	3770	0	0.0	3770	1327.22
lag_1|^GSPC	float64	3769	1	0.03	3755	1327.22
lag_2|^GSPC	float64	3768	2	0.05	3754	1327.22
lag_3|^GSPC	float64	3767	3	0.08	3753	1327.22
autocorr_1|^GSPC	float64	3770	0	0.0	1	0.9997
autocorr_2|^GSPC	float64	3770	0	0.0	1	0.9995
autocorr_3|^GSPC	float64	3770	0	0.0	1	0.9992
log_ret|^GSPC	float64	3769	1	0.03	3769	-0.0159
lag_ret_1|^GSPC	float64	3768	2	0.05	3768	-0.0159
autocorr_ret_1|^GSPC	float64	3770	0	0.0	1	-0.1193
lag_ret_2|^GSPC	float64	3767	3	0.08	3767	-0.0159
autocorr_ret_2|^GSPC	float64	3770	0	0.0	1	0.0823
lag_ret_3|^GSPC	float64	3766	4	0.11	3766	-0.0159
autocorr_ret_3|^GSPC	float64	3770	0	0.0	1	-0.0476

^GSPC • Numeric Quality

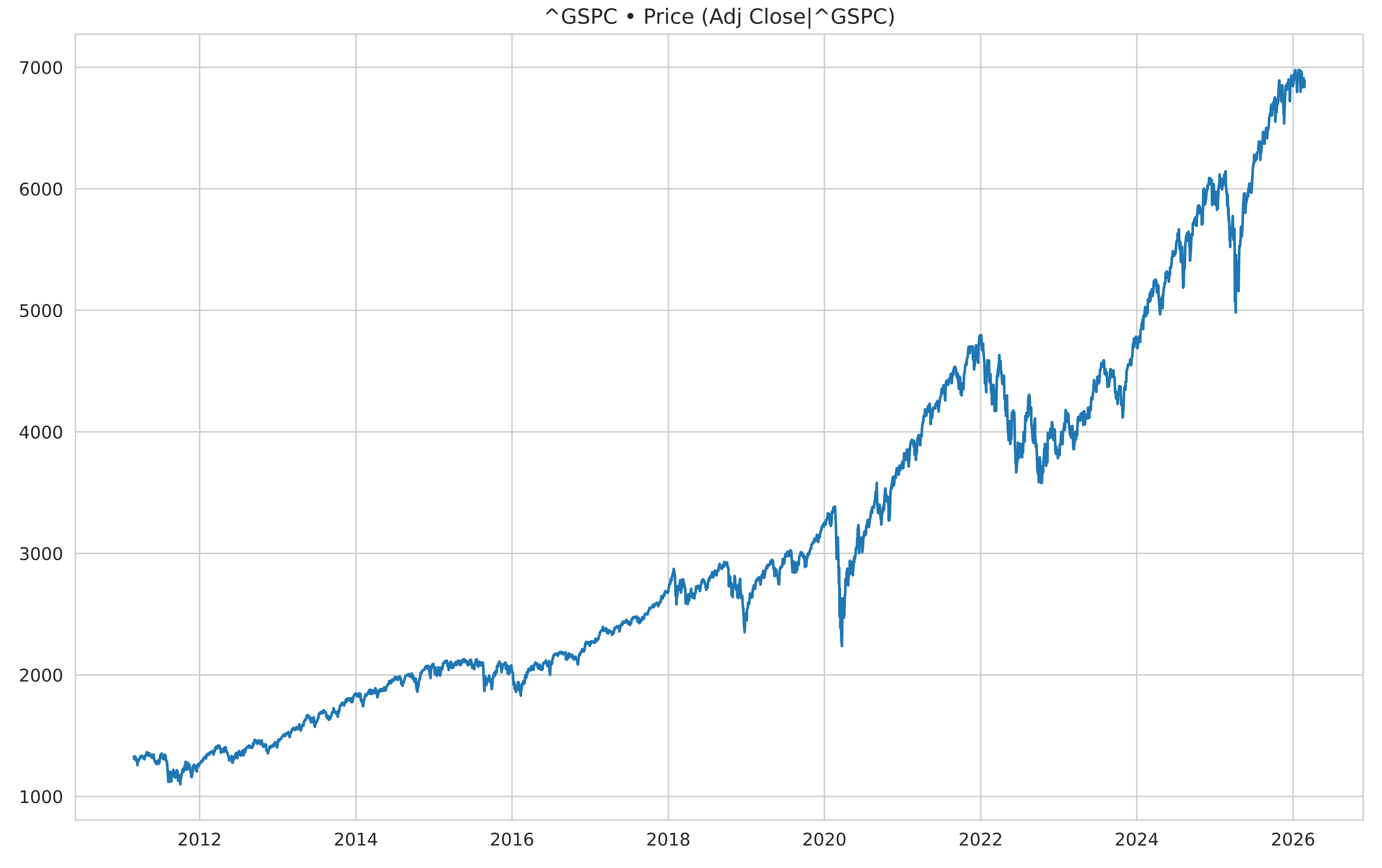
Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
Close|^GSPC	3770	0.0	0	0	1099.23	1193.6079	1972.9425	2733.15	3120.1215	4176.4849	6875.3027	6978.6001	1499.1578
Close|^GSPC	3770	0.0	0	0	1099.23	1193.6079	1972.9425	2733.15	3120.1215	4176.4849	6875.3027	6978.6001	1499.1578
High|^GSPC	3770	0.0	0	0	1125.12	1204.1208	1982.5325	2746.775	3136.0184	4197.4625	6900.9024	7002.2798	1506.3989
Low|^GSPC	3770	0.0	0	0	1074.77	1178.5655	1964.065	2716.735	3101.814	4151.4077	6833.181	6963.46	1490.9005
Open|^GSPC	3770	0.0	0	0	1097.42	1192.9521	1973.0975	2734.16	3119.5407	4176.5974	6869.2085	7002.0	1499.0314
olume|^GSPC	3770	0.0	1	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
month	3770	0.0	0	0	1.0	1.0	4.0	7.0	6.5467	10.0	12.0	12.0	3.4261
day_of_week	3770	0.0	706	0	0.0	0.0	1.0	2.0	2.0228	3.0	4.0	4.0	1.4001
quarter	3770	0.0	0	0	1.0	1.0	2.0	3.0	2.5154	4.0	4.0	4.0	1.1143
year	3770	0.0	0	0	2011.0	2011.0	2014.0	2018.0	2018.1435	2022.0	2025.0	2026.0	4.3308
s_month_end	3770	0.0	3643	0	0.0	0.0	0.0	0.0	0.0337	0.0	1.0	1.0	0.1804
s_month_start	3770	0.0	3655	0	0.0	0.0	0.0	0.0	0.0305	0.0	1.0	1.0	0.172
pread|^GSPC	3770	0.0	0	0	3.7	5.6199	14.0801	24.6802	34.2044	44.3451	140.5981	532.9097	30.7882
pread|^GSPC	3770	0.0	1	2031	-491.6201	-73.4646	-12.7475	-1.21	-0.5809	9.3848	91.2497	218.0601	29.5461
SMA_5|^GSPC	3770	0.0	0	0	1131.806	1188.151	1969.562	2727.13	3117.1748	4172.3025	6866.8135	6968.2219	1496.905
EMA_5|^GSPC	3770	0.0	0	0	1130.3616	1188.3235	1970.2184	2726.6168	3117.1786	4176.2145	6871.6567	6959.7089	1496.7602
MA_10|^GSPC	3770	0.0	0	0	1141.441	1186.1864	1967.1125	2726.827	3113.496	4174.0155	6855.5483	6942.083	1494.1932
MA_10|^GSPC	3770	0.0	0	0	1144.0708	1189.8424	1968.7688	2726.6258	3113.4935	4170.9395	6871.2851	6947.6759	1493.8673
MA_20|^GSPC	3770	0.0	0	0	1162.7745	1185.235	1963.439	2726.068	3106.087	4167.2039	6852.537	6935.8085	1488.6611
MA_20|^GSPC	3770	0.0	0	0	1157.878	1194.068	1968.9148	2726.6212	3106.1016	4151.3373	6847.4517	6929.2107	1488.0229
lag_1|^GSPC	3769	0.03	0	0	1099.23	1193.5988	1972.83	2733.01	3119.1215	4175.48	6871.9232	6978.6001	1498.0986
lag_2|^GSPC	3768	0.05	0	0	1099.23	1193.5897	1972.8075	2732.615	3118.1346	4175.2701	6871.9708	6978.6001	1497.0716
lag_3|^GSPC	3767	0.08	0	0	1099.23	1193.5806	1972.785	2732.22	3117.1281	4174.5251	6864.7835	6978.6001	1495.9948
corr_1|^GSPC	3770	0.0	0	0	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.0
corr_2|^GSPC	3770	0.0	0	0	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.0
corr_3|^GSPC	3770	0.0	0	0	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.0
og_ret|^GSPC	3769	0.03	1	1717	-0.1277	-0.0317	-0.0038	0.0007	0.0004	0.0056	0.0258	0.0909	0.0109
_ret_1|^GSPC	3768	0.05	1	1717	-0.1277	-0.0317	-0.0038	0.0007	0.0004	0.0056	0.0258	0.0909	0.0109
_ret_1|^GSPC	3770	0.0	0	3770	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	0.0
_ret_2|^GSPC	3767	0.08	1	1716	-0.1277	-0.0317	-0.0038	0.0007	0.0004	0.0056	0.0258	0.0909	0.0109
_ret_2|^GSPC	3770	0.0	0	0	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823	0.0
_ret_3|^GSPC	3766	0.11	1	1716	-0.1277	-0.0317	-0.0038	0.0007	0.0004	0.0056	0.0258	0.0909	0.0109
_ret_3|^GSPC	3770	0.0	0	3770	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	0.0

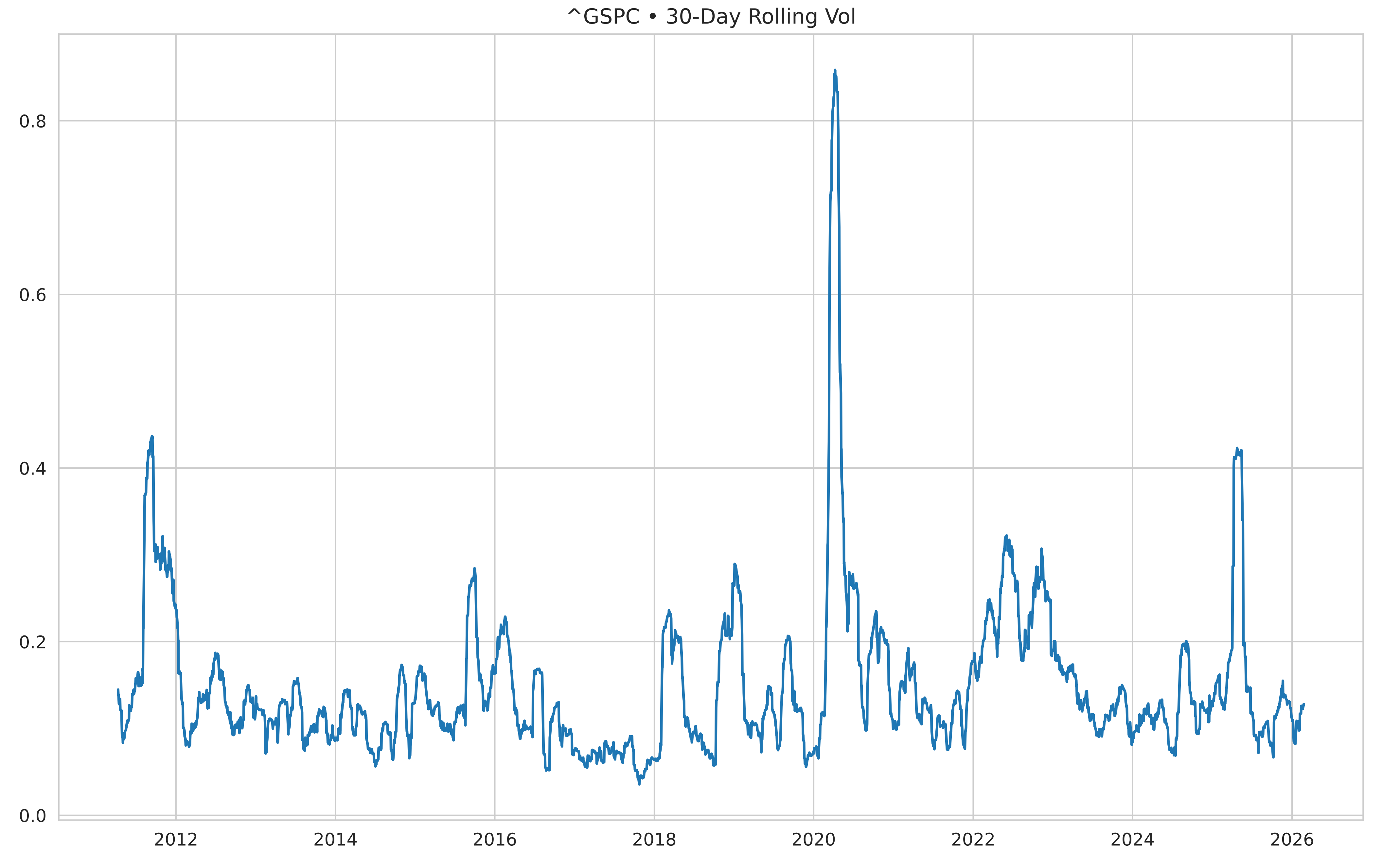
^GSPC • Describe

Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
j Close|^GSPC	3770.0	3120.1215	1499.1578	1099.23	1193.6079	1316.963	1972.9425	2733.15	4176.4849	6052.4542	6875.3027	6978.6001
Close|^GSPC	3770.0	3120.1215	1499.1578	1099.23	1193.6079	1316.963	1972.9425	2733.15	4176.4849	6052.4542	6875.3027	6978.6001
High|^GSPC	3770.0	3136.0184	1506.3989	1125.12	1204.1208	1326.594	1982.5325	2746.775	4197.4625	6079.1851	6900.9024	7002.2798
Low|^GSPC	3770.0	3101.814	1490.9005	1074.77	1178.5655	1310.168	1964.065	2716.735	4151.4077	6035.267	6833.181	6963.46
Open|^GSPC	3770.0	3119.5407	1499.0314	1097.42	1192.9521	1316.25	1973.0975	2734.16	4176.5974	6059.0475	6869.2085	7002.0
olume|^GSPC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
month	3770.0	6.5467	3.4261	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3770.0	2.0228	1.4001	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3770.0	2.5154	1.1143	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3770.0	2018.1435	4.3308	2011.0	2011.0	2011.0	2014.0	2018.0	2022.0	2025.0	2025.0	2026.0
is_month_end	3770.0	0.0337	0.1804	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3770.0	0.0305	0.172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
spread|^GSPC	3770.0	34.2044	30.7882	3.7	5.6199	7.7544	14.0801	24.6802	44.3451	90.7799	140.5981	532.9097
spread|^GSPC	3770.0	-0.5809	29.5461	-491.6201	-73.4646	-42.1156	-12.7475	-1.21	9.3848	46.295	91.2497	218.0601
SMA_5|^GSPC	3770.0	3117.1748	1496.905	1131.806	1188.151	1318.2562	1969.562	2727.13	4172.3025	6056.7935	6866.8135	6968.2219
EMA_5|^GSPC	3770.0	3117.1786	1496.7602	1130.3616	1188.3235	1318.4716	1970.2184	2726.6168	4176.2145	6052.2856	6871.6567	6959.7089
MA_10|^GSPC	3770.0	3113.496	1494.1932	1141.441	1186.1864	1318.3171	1967.1125	2726.827	4174.0155	6047.3311	6855.5483	6942.083
MA_10|^GSPC	3770.0	3113.4935	1493.8673	1144.0708	1189.8424	1320.2034	1968.7688	2726.6258	4170.9395	6036.7385	6871.2851	6947.6759
MA_20|^GSPC	3770.0	3106.087	1488.6611	1162.7745	1185.235	1315.4108	1963.439	2726.068	4167.2039	6018.8258	6852.537	6935.8085
MA_20|^GSPC	3770.0	3106.1016	1488.0229	1157.878	1194.068	1318.5918	1968.9148	2726.6212	4151.3373	6009.7874	6847.4517	6929.2107
lag_1|^GSPC	3769.0	3119.1215	1498.0986	1099.23	1193.5988	1316.926	1972.83	2733.01	4175.48	6051.6821	6871.9232	6978.6001
lag_2|^GSPC	3768.0	3118.1346	1497.0716	1099.23	1193.5897	1316.889	1972.8075	2732.615	4175.2701	6051.1939	6871.9708	6978.6001
lag_3|^GSPC	3767.0	3117.1281	1495.9948	1099.23	1193.5806	1316.852	1972.785	2732.22	4174.5251	6050.9458	6864.7835	6978.6001
ocorr_1|^GSPC	3770.0	0.9997	0.0	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
ocorr_2|^GSPC	3770.0	0.9995	0.0	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995
ocorr_3|^GSPC	3770.0	0.9992	0.0	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992
log_ret|^GSPC	3769.0	0.0004	0.0109	-0.1277	-0.0317	-0.0165	-0.0038	0.0007	0.0056	0.0154	0.0258	0.0909
g_ret_1|^GSPC	3768.0	0.0004	0.0109	-0.1277	-0.0317	-0.0165	-0.0038	0.0007	0.0056	0.0154	0.0258	0.0909
r_ret_1|^GSPC	3770.0	-0.1193	0.0	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193	-0.1193
g_ret_2|^GSPC	3767.0	0.0004	0.0109	-0.1277	-0.0317	-0.0165	-0.0038	0.0007	0.0056	0.0154	0.0258	0.0909
r_ret_2|^GSPC	3770.0	0.0823	0.0	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823	0.0823
g_ret_3|^GSPC	3766.0	0.0004	0.0109	-0.1277	-0.0317	-0.0165	-0.0038	0.0007	0.0056	0.0154	0.0258	0.0909
r_ret_3|^GSPC	3770.0	-0.0476	0.0	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476	-0.0476

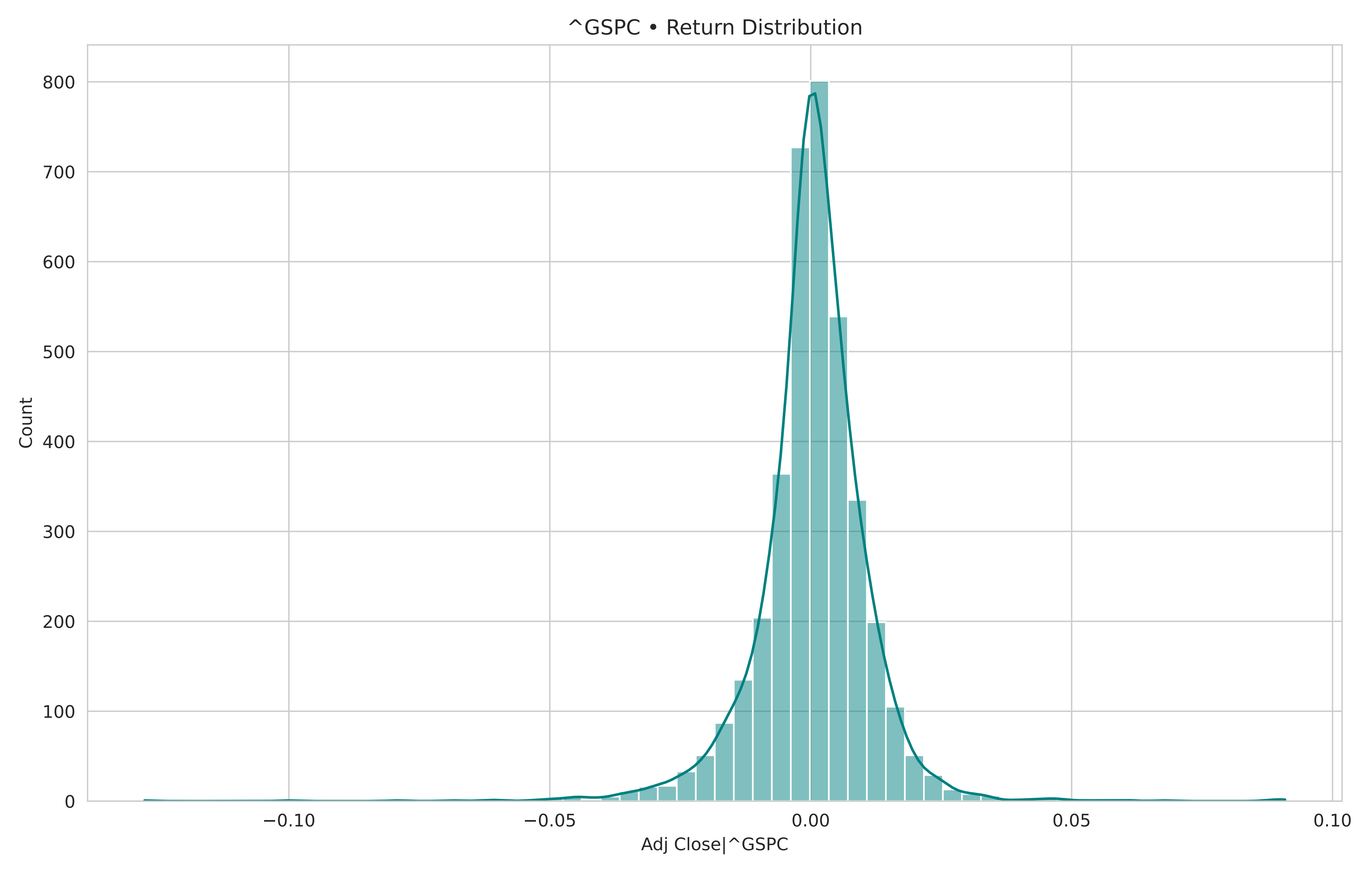


^GSPC • Correlation
Adj Close|^GSPC
Close|^GSPC
High|^GSPC
Low|^GSPC
Open|^GSPC
Volume|^GSPC
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|^GSPC
OC_spread|^GSPC
SMA_5|^GSPC
EMA_5|^GSPC
SMA_10|^GSPC
EMA_10|^GSPC
SMA_20|^GSPC
EMA_20|^GSPC
lag_1|^GSPC
lag_2|^GSPC
lag_3|^GSPC
autocorr_1|^GSPC
autocorr_2|^GSPC
autocorr_3|^GSPC
log_ret|^GSPC
lag_ret_1|^GSPC
autocorr_ret_1|^GSPC
lag_ret_2|^GSPC
autocorr_ret_2|^GSPC
lag_ret_3|^GSPC
autocorr_ret_3|^GSPC
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75


^GSPC • Price (Adj Close|^GSPC)
7000
6000
5000
4000
3000
2000
1000
2012
2014
2016
2018
2020
2022
2024
2026



^GSPC • 30-Day Rolling Vol
0.0
0.2
0.4
0.6
0.8
2012
2014
2016
2018
2020
2022
2024
2026


^GSPC • Return Distribution
800
700
600
500
400
300
200
100
0
Count
−0.10
−0.05
0.00
0.05
0.10
Adj Close|^GSPC

^VIX • Schema & Missingness

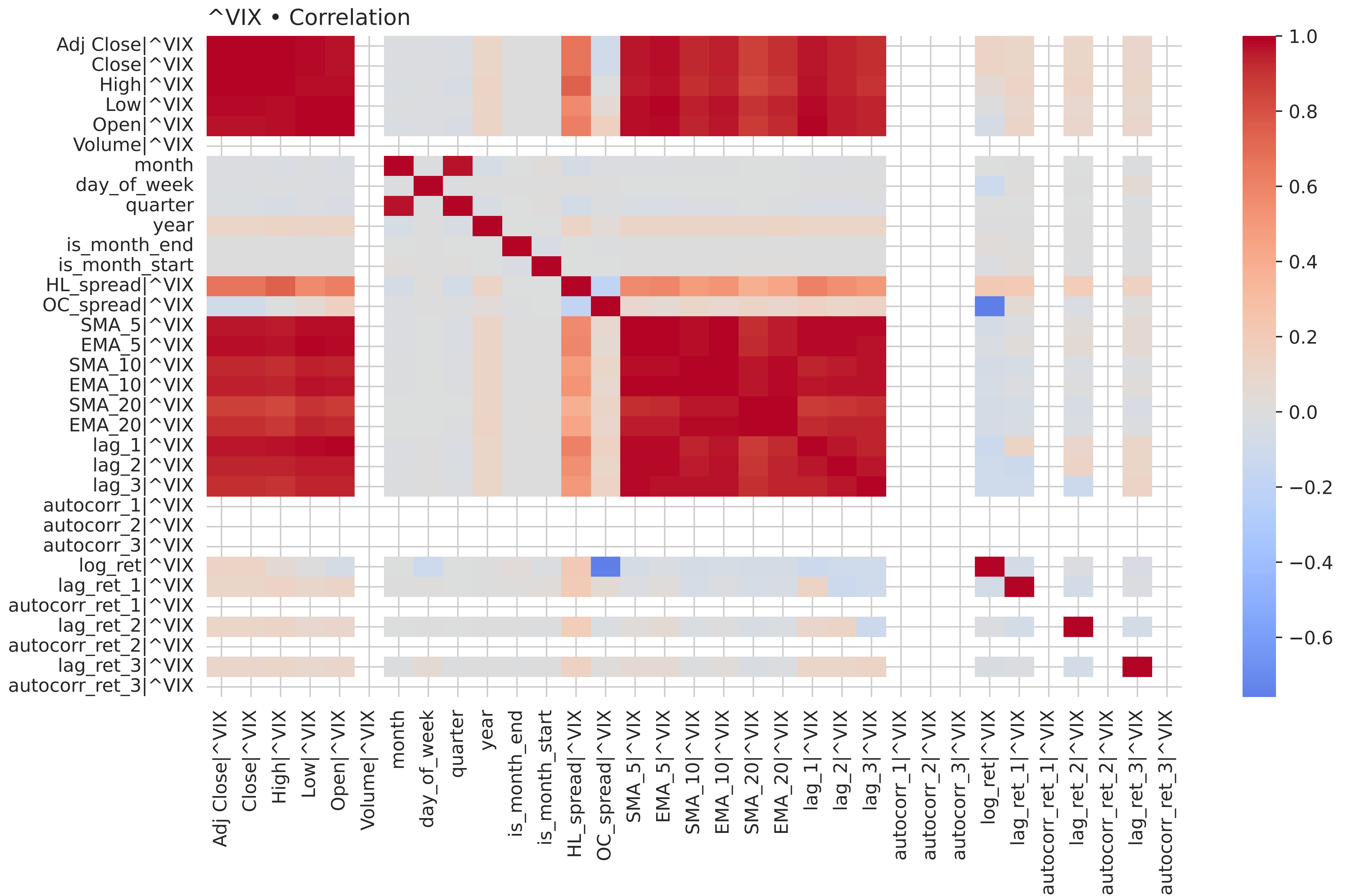
Column	dtype	non_null	missing	missing_%	unique	sample
Adj Close|^VIX	float64	3770	0	0.0	1663	18.35
Close|^VIX	float64	3770	0	0.0	1663	18.35
High|^VIX	float64	3770	0	0.0	1736	19.27
Low|^VIX	float64	3770	0	0.0	1596	18.14
Open|^VIX	float64	3770	0	0.0	1653	19.12
Volume|^VIX	int64	3770	0	0.0	1	0.0
month	int32	3770	0	0.0	12	2.0
day_of_week	int32	3770	0	0.0	5	0.0
quarter	int32	3770	0	0.0	4	1.0
year	int32	3770	0	0.0	16	2011.0
is_month_end	int64	3770	0	0.0	2	1.0
is_month_start	int64	3770	0	0.0	2	0.0
HL_spread|^VIX	float64	3770	0	0.0	1971	1.13
OC_spread|^VIX	float64	3770	0	0.0	2021	0.77
SMA_5|^VIX	float64	3770	0	0.0	3530	18.35
EMA_5|^VIX	float64	3770	0	0.0	3770	18.35
SMA_10|^VIX	float64	3770	0	0.0	3664	18.35
EMA_10|^VIX	float64	3770	0	0.0	3770	18.35
SMA_20|^VIX	float64	3770	0	0.0	3726	18.35
EMA_20|^VIX	float64	3770	0	0.0	3770	18.35
lag_1|^VIX	float64	3769	1	0.03	1663	18.35
lag_2|^VIX	float64	3768	2	0.05	1663	18.35
lag_3|^VIX	float64	3767	3	0.08	1663	18.35
autocorr_1|^VIX	float64	3770	0	0.0	1	0.9633
autocorr_2|^VIX	float64	3770	0	0.0	1	0.9388
autocorr_3|^VIX	float64	3770	0	0.0	1	0.9111
log_ret|^VIX	float64	3769	1	0.03	3738	0.1354
lag_ret_1|^VIX	float64	3768	2	0.05	3737	0.1354
autocorr_ret_1|^VIX	float64	3770	0	0.0	1	-0.0777
lag_ret_2|^VIX	float64	3767	3	0.08	3736	0.1354
autocorr_ret_2|^VIX	float64	3770	0	0.0	1	-0.0222
lag_ret_3|^VIX	float64	3766	4	0.11	3735	0.1354
autocorr_ret_3|^VIX	float64	3770	0	0.0	1	-0.0337

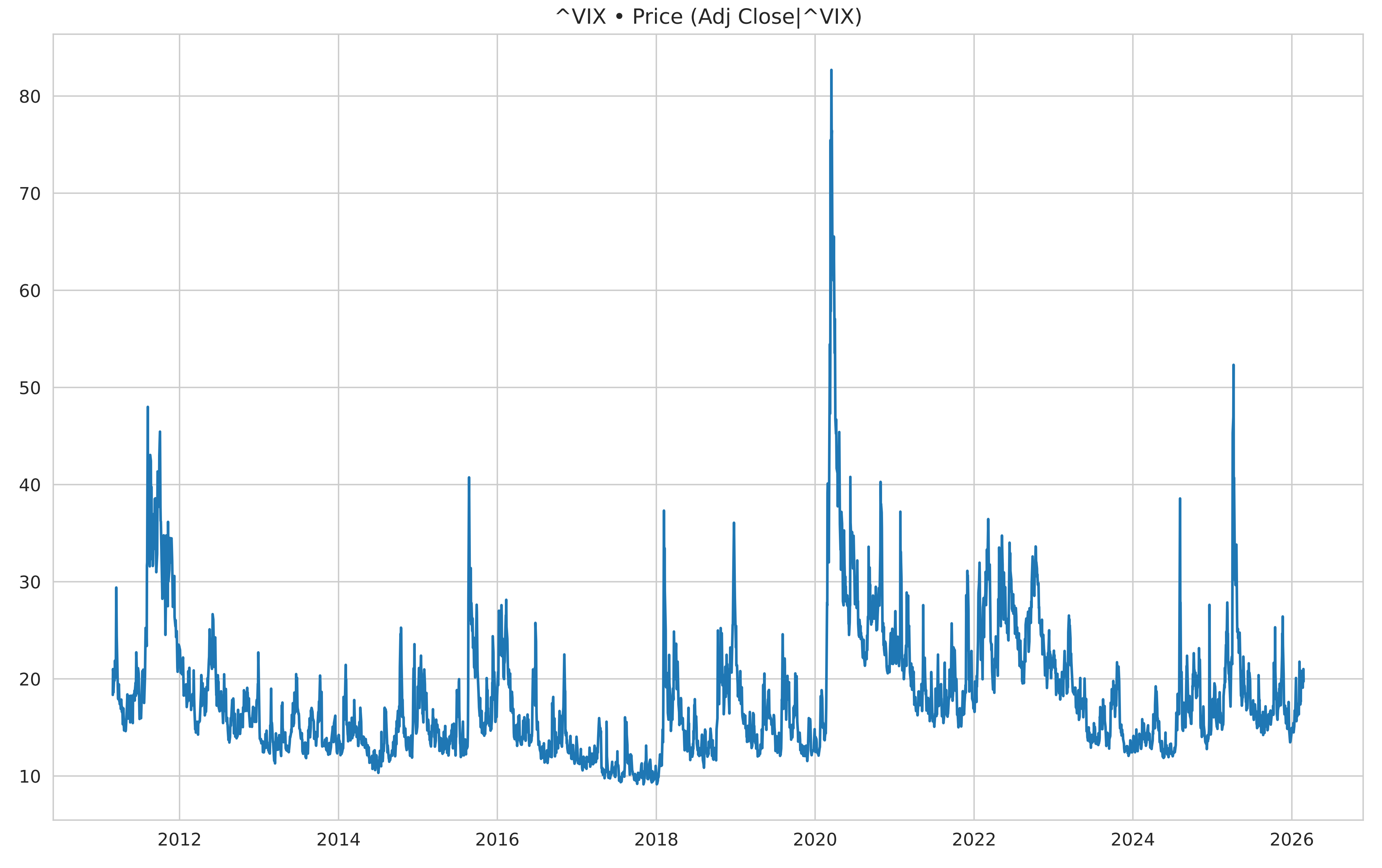
^VIX • Numeric Quality

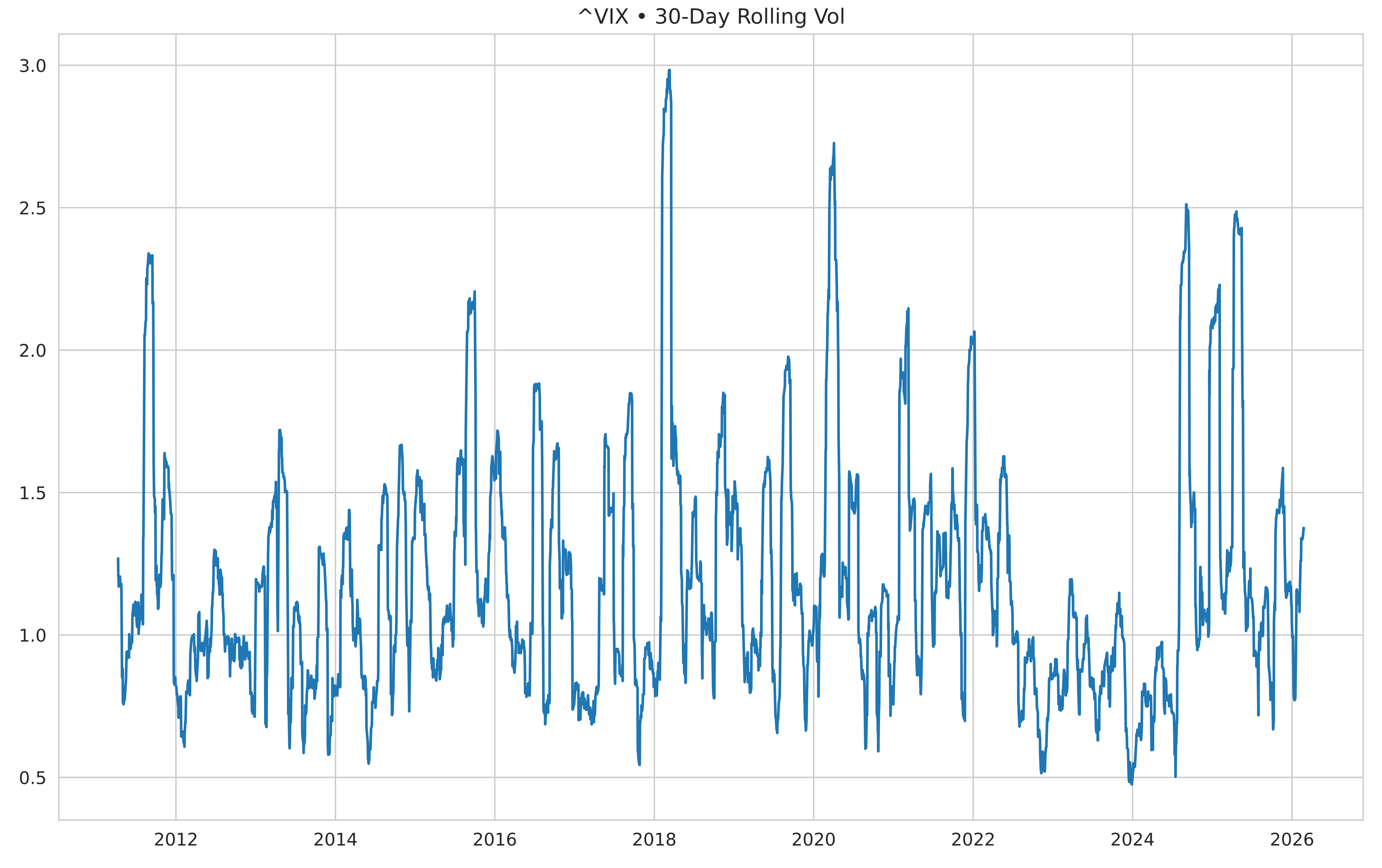
Column	non_null	missing_%	zeros	negatives	min	p01	q1	median	mean	q3	p99	max	std
dj Close|^VIX	3770	0.0	0	0	9.14	9.8169	13.5925	16.34	18.1385	20.58	41.4699	82.69	6.8825
Close|^VIX	3770	0.0	0	0	9.14	9.8169	13.5925	16.34	18.1385	20.58	41.4699	82.69	6.8825
High|^VIX	3770	0.0	0	0	9.31	10.21	14.28	17.27	19.2975	21.94	45.6472	85.47	7.6655
Low|^VIX	3770	0.0	0	0	8.56	9.5269	13.21	15.745	17.3307	19.5275	39.0324	70.37	6.2487
Open|^VIX	3770	0.0	0	0	9.01	9.8107	13.73	16.44	18.2805	20.76	42.051	82.69	6.9355
Volume|^VIX	3770	0.0	3770	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
month	3770	0.0	0	0	1.0	1.0	4.0	7.0	6.5467	10.0	12.0	12.0	3.4261
day_of_week	3770	0.0	706	0	0.0	0.0	1.0	2.0	2.0228	3.0	4.0	4.0	1.4001
quarter	3770	0.0	0	0	1.0	1.0	2.0	3.0	2.5154	4.0	4.0	4.0	1.1143
year	3770	0.0	0	0	2011.0	2011.0	2014.0	2018.0	2018.1435	2022.0	2025.0	2026.0	4.3308
s_month_end	3770	0.0	3643	0	0.0	0.0	0.0	0.0	0.0337	0.0	1.0	1.0	0.1804
s_month_start	3770	0.0	3655	0	0.0	0.0	0.0	0.0	0.0305	0.0	1.0	1.0	0.172
_spread|^VIX	3770	0.0	0	0	0.24	0.37	0.9	1.4	1.9667	2.29	10.1817	42.34	2.1363
_spread|^VIX	3770	0.0	17	1457	-24.86	-4.9117	-0.36	0.22	0.142	0.79	3.87	17.36	1.6509
SMA_5|^VIX	3770	0.0	0	0	9.376	9.8854	13.619	16.482	18.1381	20.4215	40.4191	74.618	6.7087
EMA_5|^VIX	3770	0.0	0	0	9.4674	9.935	13.6759	16.4427	18.1377	20.3734	40.0579	71.7102	6.6452
SMA_10|^VIX	3770	0.0	0	0	9.631	9.961	13.7225	16.603	18.1379	20.3385	39.5008	69.36	6.5607
EMA_10|^VIX	3770	0.0	0	0	9.6541	9.9893	13.8196	16.5723	18.1369	20.3421	39.0484	64.5751	6.4531
SMA_20|^VIX	3770	0.0	0	0	9.7825	10.1829	13.9791	16.541	18.1396	20.2487	37.7847	62.0595	6.3163
EMA_20|^VIX	3770	0.0	0	0	9.9008	10.1427	14.0083	16.6307	18.137	20.2237	38.5856	57.0974	6.1494
lag_1|^VIX	3769	0.03	0	0	9.14	9.8168	13.59	16.34	18.1381	20.58	41.4728	82.69	6.8834
lag_2|^VIX	3768	0.05	0	0	9.14	9.8167	13.59	16.34	18.1373	20.58	41.4757	82.69	6.8841
lag_3|^VIX	3767	0.08	0	0	9.14	9.8166	13.59	16.34	18.1371	20.58	41.4786	82.69	6.885
tocorr_1|^VIX	3770	0.0	0	0	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633	0.0
tocorr_2|^VIX	3770	0.0	0	0	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388	0.0
tocorr_3|^VIX	3770	0.0	0	0	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111	0.0
log_ret|^VIX	3769	0.03	19	2039	-0.4424	-0.1785	-0.0435	-0.0064	0.0	0.0357	0.2427	0.7682	0.0786
ag_ret_1|^VIX	3768	0.05	19	2038	-0.4424	-0.1785	-0.0435	-0.0063	0.0	0.0357	0.2427	0.7682	0.0786
rr_ret_1|^VIX	3770	0.0	0	3770	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	0.0
ag_ret_2|^VIX	3767	0.08	19	2038	-0.4424	-0.1786	-0.0435	-0.0064	0.0	0.0357	0.2428	0.7682	0.0786
rr_ret_2|^VIX	3770	0.0	0	3770	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	0.0
ag_ret_3|^VIX	3766	0.11	19	2037	-0.4424	-0.1786	-0.0435	-0.0063	0.0	0.0357	0.2429	0.7682	0.0786
rr_ret_3|^VIX	3770	0.0	0	3770	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	0.0

^VIX • Describe

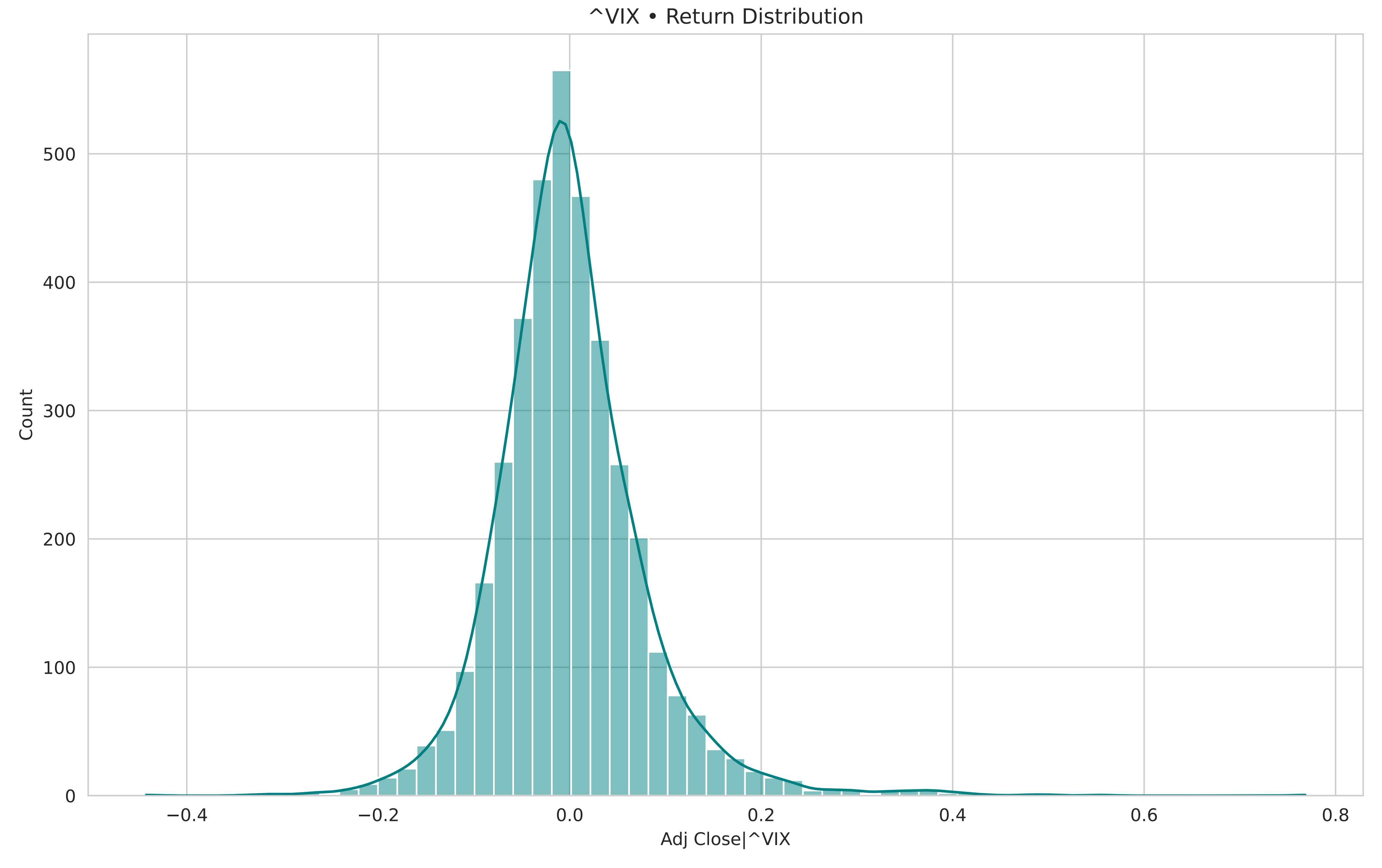
Variable	count	mean	std	min	1%	5%	25%	50%	75%	95%	99%	max
Adj Close|^VIX	3770.0	18.1385	6.8825	9.14	9.8169	11.2945	13.5925	16.34	20.58	31.2255	41.4699	82.69
Close|^VIX	3770.0	18.1385	6.8825	9.14	9.8169	11.2945	13.5925	16.34	20.58	31.2255	41.4699	82.69
High|^VIX	3770.0	19.2975	7.6655	9.31	10.21	11.84	14.28	17.27	21.94	33.39	45.6472	85.47
Low|^VIX	3770.0	17.3307	6.2487	8.56	9.5269	10.94	13.21	15.745	19.5275	29.5655	39.0324	70.37
Open|^VIX	3770.0	18.2805	6.9355	9.01	9.8107	11.3845	13.73	16.44	20.76	31.45	42.051	82.69
Volume|^VIX	3770.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
month	3770.0	6.5467	3.4261	1.0	1.0	1.0	4.0	7.0	10.0	12.0	12.0	12.0
day_of_week	3770.0	2.0228	1.4001	0.0	0.0	0.0	1.0	2.0	3.0	4.0	4.0	4.0
quarter	3770.0	2.5154	1.1143	1.0	1.0	1.0	2.0	3.0	4.0	4.0	4.0	4.0
year	3770.0	2018.1435	4.3308	2011.0	2011.0	2011.0	2014.0	2018.0	2022.0	2025.0	2025.0	2026.0
is_month_end	3770.0	0.0337	0.1804	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
s_month_start	3770.0	0.0305	0.172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
L_spread|^VIX	3770.0	1.9667	2.1363	0.24	0.37	0.53	0.9	1.4	2.29	4.8755	10.1817	42.34
C_spread|^VIX	3770.0	0.142	1.6509	-24.86	-4.9117	-2.15	-0.36	0.22	0.79	2.04	3.87	17.36
SMA_5|^VIX	3770.0	18.1381	6.7087	9.376	9.8854	11.4418	13.619	16.482	20.4215	31.0476	40.4191	74.618
EMA_5|^VIX	3770.0	18.1377	6.6452	9.4674	9.935	11.4324	13.6759	16.4427	20.3734	30.8667	40.0579	71.7102
SMA_10|^VIX	3770.0	18.1379	6.5607	9.631	9.961	11.4611	13.7225	16.603	20.3385	30.6752	39.5008	69.36
EMA_10|^VIX	3770.0	18.1369	6.4531	9.6541	9.9893	11.4825	13.8196	16.5723	20.3421	30.5567	39.0484	64.5751
SMA_20|^VIX	3770.0	18.1396	6.3163	9.7825	10.1829	11.5158	13.9791	16.541	20.2487	30.2592	37.7847	62.0595
EMA_20|^VIX	3770.0	18.137	6.1494	9.9008	10.1427	11.6066	14.0083	16.6307	20.2237	30.1789	38.5856	57.0974
lag_1|^VIX	3769.0	18.1381	6.8834	9.14	9.8168	11.294	13.59	16.34	20.58	31.226	41.4728	82.69
lag_2|^VIX	3768.0	18.1373	6.8841	9.14	9.8167	11.2935	13.59	16.34	20.58	31.2265	41.4757	82.69
lag_3|^VIX	3767.0	18.1371	6.885	9.14	9.8166	11.293	13.59	16.34	20.58	31.227	41.4786	82.69
utocorr_1|^VIX	3770.0	0.9633	0.0	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633	0.9633
utocorr_2|^VIX	3770.0	0.9388	0.0	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388	0.9388
utocorr_3|^VIX	3770.0	0.9111	0.0	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111	0.9111
log_ret|^VIX	3769.0	0.0	0.0786	-0.4424	-0.1785	-0.1095	-0.0435	-0.0064	0.0357	0.128	0.2427	0.7682
ag_ret_1|^VIX	3768.0	0.0	0.0786	-0.4424	-0.1785	-0.1095	-0.0435	-0.0063	0.0357	0.128	0.2427	0.7682
orr_ret_1|^VIX	3770.0	-0.0777	0.0	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777	-0.0777
ag_ret_2|^VIX	3767.0	0.0	0.0786	-0.4424	-0.1786	-0.1095	-0.0435	-0.0064	0.0357	0.128	0.2428	0.7682
orr_ret_2|^VIX	3770.0	-0.0222	0.0	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222	-0.0222
ag_ret_3|^VIX	3766.0	0.0	0.0786	-0.4424	-0.1786	-0.1095	-0.0435	-0.0063	0.0357	0.128	0.2429	0.7682
orr_ret_3|^VIX	3770.0	-0.0337	0.0	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337	-0.0337

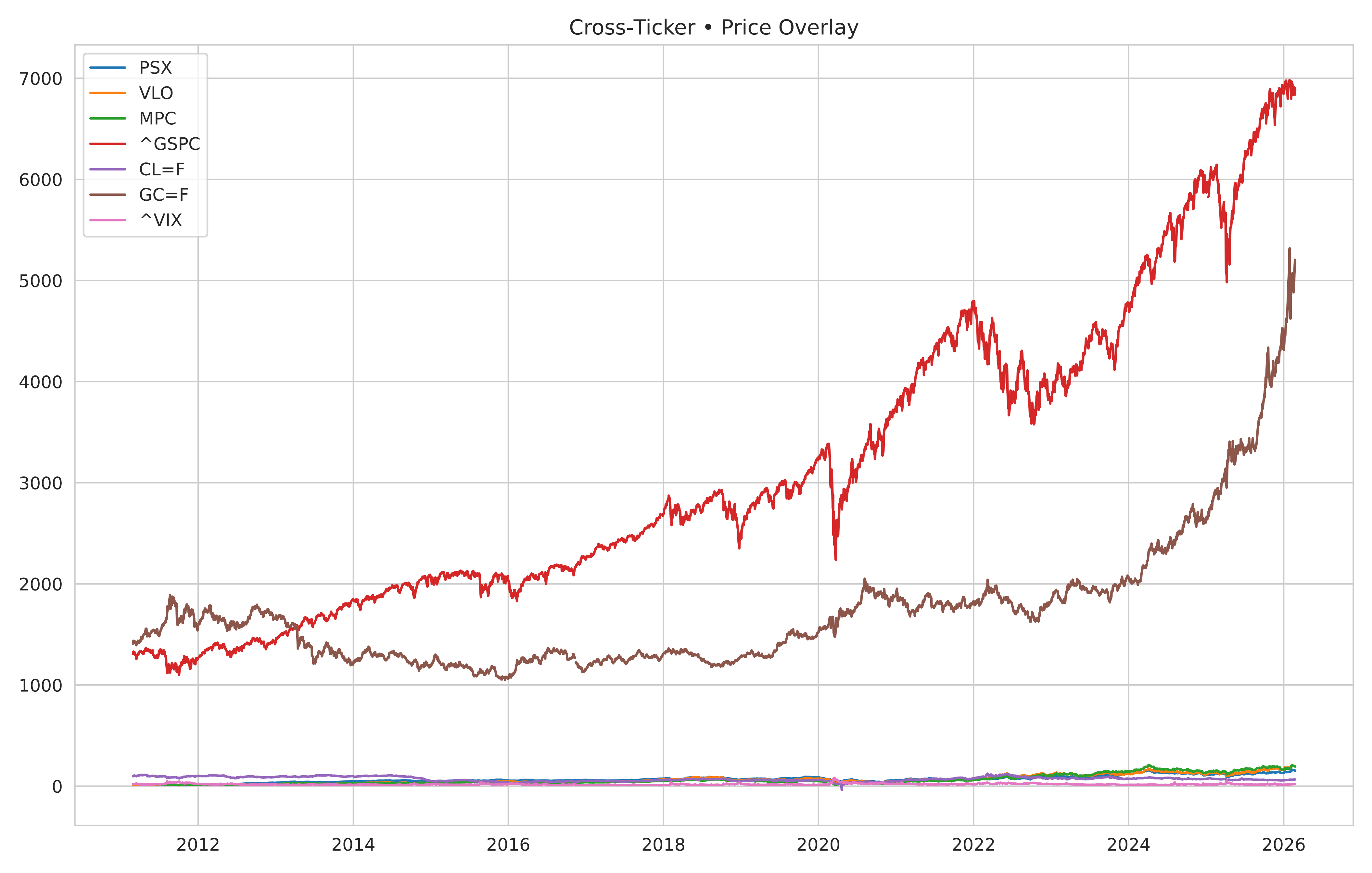

^VIX • Correlation
Adj Close|^VIX
Close|^VIX
High|^VIX
Low|^VIX
Open|^VIX
Volume|^VIX
month
day_of_week
quarter
year
is_month_end
is_month_start
HL_spread|^VIX
OC_spread|^VIX
SMA_5|^VIX
EMA_5|^VIX
SMA_10|^VIX
EMA_10|^VIX
SMA_20|^VIX
EMA_20|^VIX
lag_1|^VIX
lag_2|^VIX
lag_3|^VIX
autocorr_1|^VIX
autocorr_2|^VIX
autocorr_3|^VIX
log_ret|^VIX
lag_ret_1|^VIX
autocorr_ret_1|^VIX
lag_ret_2|^VIX
autocorr_ret_2|^VIX
lag_ret_3|^VIX
autocorr_ret_3|^VIX
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6

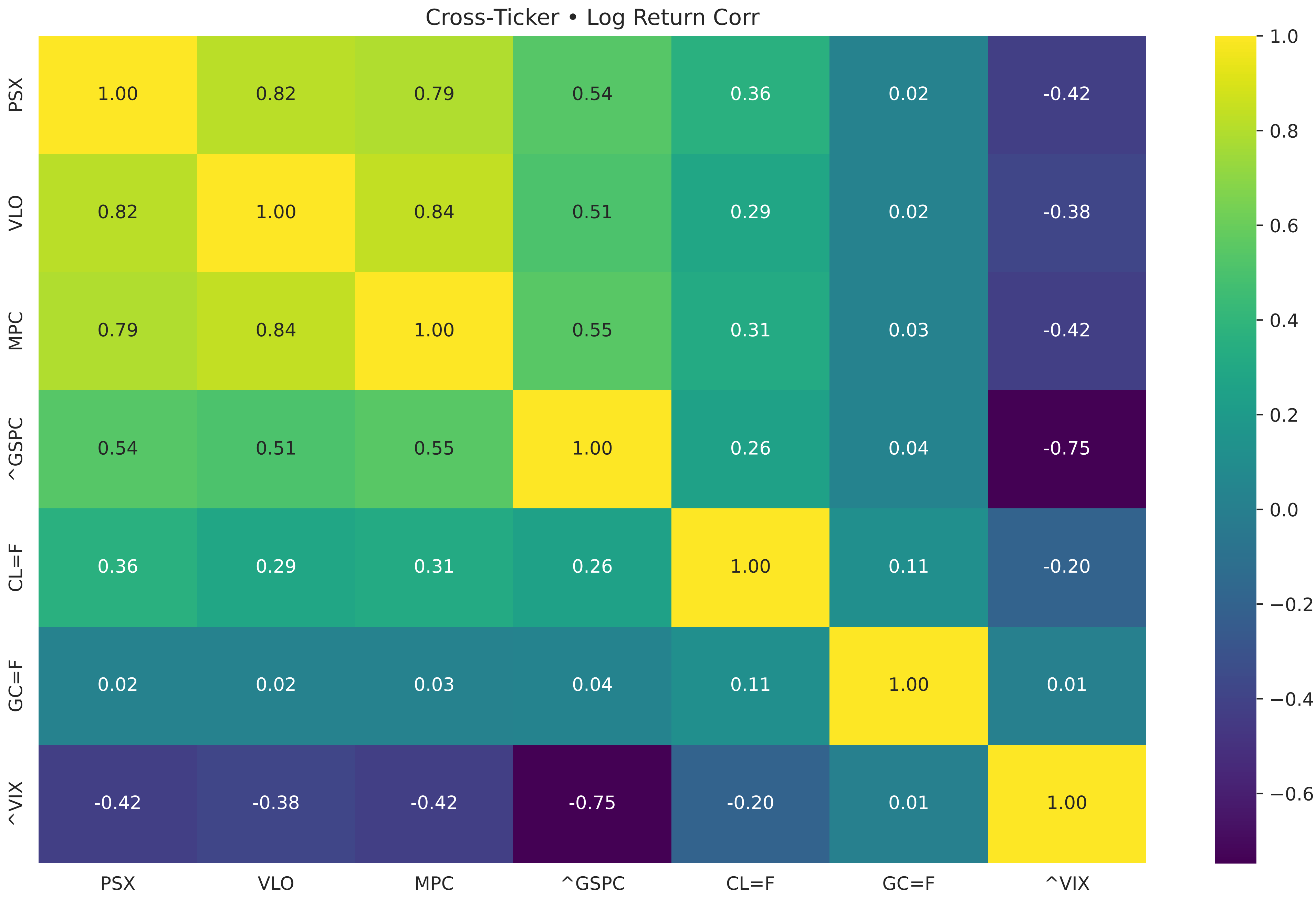

^VIX • Price (Adj Close|^VIX)
80
70
60
50
40
30
20
10
2012
2014
2016
2018
2020
2022
2024
2026



^VIX • 30-Day Rolling Vol
3.0
2.5
2.0
1.5
1.0
0.5
2012
2014
2016
2018
2020
2022
2024
2026


^VIX • Return Distribution
Count
Adj Close|^VIX
0
100
200
300
400
500
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8


Cross-Ticker • Price Overlay
PSX
VLO
MPC
^GSPC
CL=F
GC=F
^VIX
7000
6000
5000
4000
3000
2000
1000
0
2012
2014
2016
2018
2020
2022
2024
2026


Cross-Ticker • Log Return Corr
PSX
VLO
MPC
^GSPC
CL=F
GC=F
^VIX
1.00
0.82
0.79
0.54
0.36
0.02
-0.42
0.82
1.00
0.84
0.51
0.29
0.02
-0.38
0.79
0.84
1.00
0.55
0.31
0.03
-0.42
0.54
0.51
0.55
1.00
0.26
0.04
-0.75
0.36
0.29
0.31
0.26
1.00
0.11
-0.20
0.02
0.02
0.03
0.04
0.11
1.00
0.01
-0.42
-0.38
-0.42
-0.75
-0.20
0.01
1.00
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6