

A combination of time series models and technical analysis for Vietnamese stock trading

Hung Nguyen¹

Abstract. This study use 8 technical analysis trading rules and 3 time series models to determine when we should be in or out of the market for stocks in Vietnamese market from Feb 01, 2002 to May 17, 2013. The result shows that there are different aspects of stock return that captured by technical trading rules and time series models. By combining of time series models signal and moving average signal using simple combination form, trader can significantly lower the number of transactions. Long periods (20 years for Vietnamese market) may be needed for technical trading rules to have significant predictive content and more complicated (non-linear) combination of technical trading rules and time series model should be examined to find improvement in forecasting return.

Keywords: Moving average predictivity, time series models, Vietnam's stock market, rolling technique, trading strategy.

1 Introduction

Technical analysis is a powerful tool for the trader to recognize trends, patterns, look for confirming market actions, or determine signs of changing supply and demand. Among those indicators that used most is the popular moving average (MA) and the MA crossover.

Murphy, senior analyst at ChartAdvisor.com, commented on the MA and how users should handle it as: "Moving averages are a totally customizable indicator, which means that the user can freely choose whatever time frame they want when creating the average. There is no right time frame to use when setting up your moving averages. The best way to figure out which one works best for you is to experiment with a number of different time periods until you find one that fits your strategy."

Many studies suggest that asset returns are correlated and hence, predictability can be captured, at least to some degree, by technical trading rules or by certain time series models. Brock et al.(1992), Bessembinder et al. (1997) and Metghalchi et al. (2008) emphasis that technical trading rules have significant predictivity power where as Yu et al. (2013) shows that the combined strategy of technical trading rules and time series models can outperform the individual one.

The primary purpose of this research is to examine trading strategies in Vietnamese market which combine signals given by technical analysis and time series models. This paper is organized as follows: Section 2 is devoted to some analysis of the stock's data. Section 3 provides technical trading rules and forecasts based on conventional time series models. Section 4 contains analysis of combined trading strategies in both full sample and subsamples. Section 5 summarizes and concludes the result.

2 Methodology and data

The data used in this study are six stocks across many sector in Vietnamese market. These are: AGF (An Giang Fisheries Import Export Joint Stock Company), COM (Materiel - Petroleum Joint Stock company), DHA (Hoa An Joint Stock Company), STB (Saigon Commercial Bank), GIL (Binh Thanh Import Export Production Business Corporation) and VNM (Vinamilk Corporation).

¹Hoa Sen University, Applied Math., Science & Technology Depart., HCMC, hung.nguyenba@hoasen.edu.vn

	AGF	COM	DHA	GIL	STB	VNM
(*)EPS (Thousand Dong)	3.17	1.57	0.48	1.83	0.62	7.7
P/E	9.29	17.1	15.71	13.44	27.22	16.89
Book Value (Thousand Dong)	26.26	26.23	19.78	22.92	12.47	20.43
(**)Beta	0.01	0.14	0.38	0.42	0.49	1.1
Market Cap (Billion Dong)	511.8	369.94	114.47	339.59	1903.45	108353.81
PTM (2012)	1.49%	0.64%	8.74%	4.67%	7.53%	25.57%
ROE (2012)	5.16%	6.87%	5.03%	9.66%	7.32%	37.56%
Nb. Of Obs.	2666	1819	2706	1693	2255	1404
Mean	0.00042935	0.001591	0.000712	0.000323	0.000141	0.001131
Min	-0.1126761	-0.06254	-0.07732	-0.0921	-0.11719	-0.06984
Max	0.07	0.056075	0.069841	0.064675	0.050136	0.099995
Std	0.02423307	0.022497	0.023962	0.023722	0.024348	0.029209
Skewness	0.04643058	0.131651	0.055373	0.146896	-0.05833	-0.01964
Kurtosis	0.29322519	0.142362	0.109169	0.189935	0.254328	-0.58089
Nb. Of Obs. with return						
> 0	1041	731	1073	650	905	591
< 0	1075	703	1055	743	937	514
> 0.001	1041	731	1073	650	905	591
< -0.001	1075	703	1055	743	937	513
> 0.01	687	514	734	438	640	468
< -0.01	701	462	714	486	673	437
> 0.1	0	0	0	0	0	0
< -0.1	1	0	0	0	2	0
Autocorrelation at lag						
1	0.11233567*	0.163288*	0.100662*	0.23467*	0.109902*	-0.0388*
2	-0.059698	-0.04142	-0.03783	-0.00337	-0.02633	-0.01722
3	-0.0171272	-0.03623	-0.00335	0.006545	-0.03264	-0.06755
4	0.04217086	0.04366	-0.01037	0.075061	0.043011	-0.01426
5	0.01509913	0.050556	0.059016	0.058657	0.026229	0.027162
6	-0.0264016	-0.02082	0.053933	0.012852	0.024308	-0.02694
7	0.0389833	0.03697	-0.02831	-0.01281	0.007928	0.003967
8	0.04275433	-0.00683	-0.01375	0.005199	0.067758	-0.02366
9	0.0091628	-0.00379	-0.03908	0.013933	0.028448	0.043501
10	-0.0062737	-0.03414	-0.02245	0.020716	-0.00194	0.035052
20	-0.0211844	0.004495	-0.00801	0.018739	0.013239	0.008495
30	-0.0092352	-0.04014	-0.03767	0.000351	-0.00818	0.007483
40	0.06081654	-0.00385	0.034059	-0.00246	0.007408	0.007577
50	0.04475121	0.032336	0.004273	0.031392	0.025839	0.033887

(*)Data is calculated up to the first quarter of 2013. (**)Beta is calculated using 100 recent sessions.

Table 1: Data analysis

We could see that the VNM, STB, GIL and DHA are the most profitable stocks for investing during the 2009 - 2012 period, AGF and COM performed below the average when we prefer to invest in the stocks that have the sum of pretax margin and return on equity about 50%. The mean return of VNM and COM are 0.1591% and 0.1131% per trading day or 39.755% and 28.275% per year, respectively, a much higher compared to the four previous one. The standard deviations of all stock are approximately of the same magnitude (around 2.3% daily or 36.5% annually). This table also shows the sign of skewness and fatter tail of almost stock except COM.

The computation of autocorrelation with lag ranging from 1 to 50 is also reported in this table. The first order autocorrelation of AGF, VNM, GIL, STB, DHA are all positive and have the largest value within each series.

In this study, 8 trading rules: (1, 50, 0), (1, 50, 0.01), (5, 100, 0), (5, 100, 0.01), (2,200,0), (2,200,0.01), (5,150,0), (5,150,0.01) are examined. The technical trading rule (m_1, m_2, d) with d is the band and two exponential moving averages EMA_1, EMA_2 with length $1 \leq m_1 < m_2$, respectively, is defined as:

Buy signals is generated at time $\{t_i, i \geq 1\}$ if:

$$EMA_2(t_i) - EMA_1(t_i) > dy_{t-1},$$

where y_t is the stock price at day t . Sell signals is generated at time $\{t_i, i \geq 1\}$ if:

$$EMA_1(t_i) - EMA_2(t_i) > dy_{t-1}.$$

One autoregressive processes model AR(1) and two autoregressive processes with GARCH in mean: AR(1)-GARCH(1,1) and AR(1)-EGARCH(1,1) are chosen to fit the data. A buy (sell) signal is generated at time $t - 1$ if:

$$E(X_t|I_{t-1}) > c (< -c),$$

where X_t is the log return at time t , I_t is the information set at time t and c is a predetermined non-negative constant. The constant c could be non-zero due to the consideration of some factors such as trading costs. In this study, it is simply taken to be 0 which means buy (sell) signal is generated when the predicted return is positive (negative).

Denote $N(\text{buy})$ and $N(\text{sell})$ as the numbers of buy and sell days, respectively. $N(\text{trading})$ is the number of days when new trading signals arrive to shift the position from buy to sell or vice versa. $L(\text{buy})$ and $L(\text{sell})$ the average number of days in long and short position. The average return of buy days and sell days which are denoted as Buy and Sell. To measure the predictive power for excess return over the simple Buy-and-Hold strategy we use the quantity Buy-Sell as the excess return of day t : $r_t = R_t - i_t$ where R_t is the return of the stock at day t and i_t is the basic interest rate at day t .

We consider a “double-or-out” strategy in [2] where trader holds the stock in the absence of trading signal, sells the stock in response to sell signal and borrows to double stock position in response to buy signal. Denote p_{it} the additional return that a trader earn at day t by using technical trading rule i .

$$\text{Let: } p_i^B = \sum_{\text{buydays}} p_{it}; \quad p_i^S = \sum_{\text{selldays}} p_{it}, \quad \text{and} \quad p_i = p_i^B + p_i^S.$$

According to [9], we can check whether the technical trading rule i has power to improve returns by testing whether p_i differs significantly from zero using t-statistics.

The rolling techniques is also applied by using the windows lengths equal to the long moving average of the combining strategy to reduce the risk of over fitting.

3 Empirical results

	AGF			COM			DHA		
	Buy	Sell	Buy-Sell	Buy	Sell	Buy-Sell	Buy	Sell	Buy-Sell
(1, 50, 0)	0.00114	-0.0002	0.00129	0.00036	0.00199	-0.0016	0.00176	-0.0014	0.00318
(1, 50, 0.01)	0.00161	-0.0003	0.00193	0.00016	0.00245	-0.0023	0.00172	-0.0018	0.0035
(5, 100, 0)	0.00146	-0.0005	0.00194	0.00101	0.00112	-0.0001	0.00144	-0.0012	0.00263
(5, 100, 0.01)	0.00184	-0.0006	0.0024	0.00075	0.00119	-0.0004	0.00137	-0.0014	0.0028
(2, 200, 0)	0.00111	-0.0003	0.00136	0.00051	0.002	-0.0015	0.00153	-0.0011	0.0026
(2, 200, 0.01)	0.00114	-0.0005	0.00159	0.00072	0.0019	-0.0012	0.00159	-0.001	0.00256
(5, 150, 0)	0.00101	-0.0001	0.00113	0.00071	0.00165	-0.0009	0.00158	-0.0013	0.00288
(5, 150, 0.01)	0.00121	-0.0002	0.00138	0.00098	0.00186	-0.0009	0.00143	-0.0012	0.00263
Average	0.00131	-0.0003	0.00163	0.00065	0.00177	-0.0011	0.00155	-0.0013	0.00285
AR	0.0031	0.00244	0.00066	0.00063	0.00218	-0.00155	0.00252	0.00182	0.0007
AR-GARCH	0.00288	0.00126	0.00162	-0.00031	0.00228	-0.00258	0.00244	0.00075	0.00169
AR-EGARCH	0.00288	0.00134	0.00155	-0.00013	0.00221	-0.00233	0.00242	-3.5E-05	0.00246
Average	0.00296	0.00168	0.00127	6.6E-05	0.00222	-0.00216	0.00246	0.00085	0.00162
	GIL			STB			VNM		
(1, 50, 0)	0.00099	0.0004	0.00059	0.00151	-0.0006	0.00211	0.00199*	0.00077*	0.00122
(1, 50, 0.01)	0.00076	0.00026	0.0005	0.00238	-0.0006	0.00299	0.00219*	0.0007	0.00149
(5, 100, 0)	0.00121	-2E-05	0.00123	0.00146	-0.0005	0.00194	0.00194*	0.00075*	0.00118
(5, 100, 0.01)	0.00106	-8E-06	0.00107	0.00236	-0.0009	0.00326	0.00222*	0.00038	0.00184*
(2, 200, 0)	0.00111	-0.0001	0.00124	0.00129	-0.0004	0.00166	0.00181*	0.00052*	0.00129*
(2, 200, 0.01)	0.00105	-0.0003	0.00131	0.00135	-0.0003	0.00169	0.00185*	-3E-05	0.00188*
(5, 150, 0)	0.00123	-0.0001	0.00136	0.00174	-0.0007	0.00243	0.00202	0.00034*	0.00169*
(5, 150, 0.01)	0.00129	-0.0002	0.00146	0.00173	-0.0006	0.00235	0.00206	0.00012*	0.00194*
Average	0.00109	-8E-06	0.0011	0.00173	-0.0006	0.0023	0.00201	0.00044	0.00156
AR	0.00325	0.00147	0.00178	0.0043	0.00236	0.00194	0.00473	0.00944	-0.00471
AR-GARCH	0.0031	0.00112	0.00198	0.00443	0.00132	0.00311	0.00467	0.00224	0.00244
AR-EGARCH	0.00327	0.0014	0.00186	0.00443	0.00164	0.00279	0.00467	0.0022	0.00247
Average	0.00321	0.00133	0.00187	0.00439	0.00177	0.00262	0.00469	0.00462	6.7E-05

(*) Values are statistically different from zero at 5% level of significance.

Table 2: Technical trading rule and time series signals return

Buy signals generate higher return for all stocks and the trading rule with bands only give more return to the trader if apply for AGF and VNM. There is no clear evidence that show the priority of trading rules with band than those without band for each stock.

Analyze the sub-samples data (cf. Appendix) where full sample data is divided into 3 periods in which stocks move uptrend, downtrend and sideways respectively. We found that the buy signals return given by time series forecasting is greater than the buy signals return given by technical trading rules in all the three periods except for the COM in sideways period and the time series model is superior in downtrend.

	N(buy)	N(sell)	N(trading)	Lbuy	Lsell
AGF					
(1, 50, 0)	1233	1433	209	11.856	13.779
(1, 50, 0.01)	1049	1213	358	8.6694	10.025
(5, 100, 0)	1254	1412	49	52.25	58.833
(5, 100, 0.01)	1140	1288	105	38	42.933
(2, 200, 0)	1334	1332	69	39.235	39.176
(2, 200, 0.01)	1235	1248	124	36.324	36.706
(5, 150, 0)	1296	1370	51	51.84	54.8
(5, 150, 0.01)	1195	1260	91	54.318	57.273
AR	1230	1435	1421	1.73239	2.02113
AR-GARCH	1407	1258	1407	2.00142	1.78947
AR-EGARCH	1450	1215	1357	2.13864	1.79204
COM					
(1, 50, 0)	801	603	180	8.9	6.7
(1, 50, 0.01)	694	522	302	7.4624	5.6129
(5, 100, 0)	881	523	48	36.708	21.792
(5, 100, 0.01)	818	447	88	40.9	22.35
(2, 200, 0)	891	513	50	35.64	20.52
(2, 200, 0.01)	844	474	88	30.143	16.929
(5, 150, 0)	897	507	36	49.833	28.167
(5, 150, 0.01)	848	455	70	44.632	23.947
AR	651	752	618	2.11364	2.44156
AR-GARCH	809	594	602	2.69667	1.98
AR-EGARCH	849	554	614	2.77451	1.81046
DHA					
(1, 50, 0)	1118	1137	123	18.032	18.339
(1, 50, 0.01)	1004	1061	240	14.985	15.836
(5, 100, 0)	1151	1104	39	57.55	55.2
(5, 100, 0.01)	1070	1056	74	76.429	75.429
(2, 200, 0)	1064	1191	31	66.5	74.438
(2, 200, 0.01)	1041	1157	44	69.4	77.133
(5, 150, 0)	1135	1120	23	94.583	93.333
(5, 150, 0.01)	1089	1082	54	99	98.364
AR	1168	1086	1165	2.00687	1.86598
AR-GARCH	1055	1199	1152	1.8316	2.0816
AR-EGARCH	1050	1204	1148	1.82927	2.09756
GIL					
(1, 50, 0)	1423	1283	210	13.552	12.219
(1, 50, 0.01)	1267	1126	358	12.798	11.374
(5, 100, 0)	1574	1132	50	62.96	45.28
(5, 100, 0.01)	1473	1044	106	61.375	43.5
(2, 200, 0)	1756	950	56	62.714	33.929
(2, 200, 0.01)	1683	858	99	73.174	37.304
(5, 150, 0)	1631	1075	44	74.136	48.864
(5, 150, 0.01)	1565	999	78	78.25	49.95
AR	1230	1475	1383	1.78003	2.13459
AR-GARCH	1240	1465	1385	1.79191	2.11705
AR-EGARCH	1240	1465	1387	1.78932	2.114
STB					
(1, 50, 0)	750	943	101	15	18.86
(1, 50, 0.01)	682	875	162	13.918	17.857
(5, 100, 0)	710	983	35	41.765	57.824
(5, 100, 0.01)	651	926	63	43.4	61.733
(2, 200, 0)	726	967	29	51.857	69.071
(2, 200, 0.01)	711	951	48	59.25	79.25
(5, 150, 0)	720	973	21	72	97.3
(5, 150, 0.01)	697	941	45	69.7	94.1
AR	866	826	870	1.9908	1.89885
AR-GARCH	864	828	832	2.07692	1.99038
AR-EGARCH	864	828	832	2.07692	1.99038
VNM					
(1, 50, 0)	1164	655	129	18.188	10.234
(1, 50, 0.01)	1051	540	205	18.439	9.4737
(5, 100, 0)	1221	598	29	87.214	42.714
(5, 100, 0.01)	1156	522	65	68	30.706
(2, 200, 0)	1409	410	39	74.158	21.579
(2, 200, 0.01)	1343	364	63	149.22	40.444
(5, 150, 0)	1295	524	23	117.73	47.636
(5, 150, 0.01)	1236	451	50	82.4	30.067
AR	856	962	930	1.84086	2.06882
AR-GARCH	863	955	922	1.87202	2.07158
AR-EGARCH	863	955	922	1.87202	2.07158

Table 3: Technical trading rules and Time series trading stats

Table 3 gives us the results for 3 time series models and 8 technical trading rules based on out-of-sample forecasts over the full sample period. There are more buy signals generated than sell signals for COM, GIL, STB, and VNM, so Lsell is shorter than Lbuy on these four stocks, in contrast with AGF and DHA. Compared with the rule without band, the number of transactions of the trading rule with band reduces significantly about 5% to 30%.

Combined strategy

From tables 1 and 2, the AR(1) appears to be most effective time series model in predicting return, this study use AR(1) model to combine with the technical trading rules. The combined trading strategy evaluated is based on the 8 technical trading rules and the AR(1) model with the rolling window size equal to the length of the long moving average.

	N(buy)	N(sell)	N(trading)	Lbuy	Lsell
AGF					
(1, 50, 0)	226	360	72	6.2778	10
(1, 50, 0.01)	205	323	111	5	7.878
(5, 100, 0)	208	378	14	29.714	54
(5, 100, 0.01)	189	359	42	15.75	29.917
(2, 200, 0)	199	387	24	16.583	32.25
(2, 200, 0.01)	189	370	41	14.538	28.462
(5, 150, 0)	209	377	20	20.9	37.7
(5, 150, 0.01)	187	357	37	20.778	39.667
COM					
(1, 50, 0)	312	275	85	7.4286	6.5476
(1, 50, 0.01)	265	237	140	5.7609	5.1522
(5, 100, 0)	316	271	25	26.333	22.583
(5, 100, 0.01)	296	229	45	26.909	20.818
(2, 200, 0)	337	250	27	25.923	19.231
(2, 200, 0.01)	321	223	51	22.929	15.929
(5, 150, 0)	336	251	19	37.333	27.889
(5, 150, 0.01)	316	225	40	31.6	22.5
DHA					
(1, 50, 0)	168	419	24	14	34.917
(1, 50, 0.01)	150	396	55	7.8947	20.842
(5, 100, 0)	132	455	8	33	113.75
(5, 100, 0.01)	121	446	8	40.333	148.67
(2, 200, 0)	55	532	16	6.875	66.5
(2, 200, 0.01)	47	510	17	7.8333	85
(5, 150, 0)	113	474	8	28.25	118.5
(5, 150, 0.01)	96	462	16	32	154
GIL					
(1, 50, 0)	371	216	48	15.458	9
(1, 50, 0.01)	345	191	88	15.682	8.6818
(5, 100, 0)	398	189	12	66.333	31.5
(5, 100, 0.01)	379	172	26	63.167	28.667
(2, 200, 0)	399	188	18	44.333	20.889
(2, 200, 0.01)	384	169	31	42.667	18.778
(5, 150, 0)	398	189	14	56.857	27
(5, 150, 0.01)	378	174	23	63	29
STB					
(1, 50, 0)	313	274	39	16.474	14.421
(1, 50, 0.01)	286	242	64	15.053	12.737
(5, 100, 0)	358	229	17	44.75	28.625
(5, 100, 0.01)	316	199	31	63.2	39.8
(2, 200, 0)	376	211	19	41.778	23.444
(2, 200, 0.01)	357	189	28	59.5	31.5
(5, 150, 0)	375	212	13	62.5	35.333
(5, 150, 0.01)	354	189	16	118	63
VNM					
(1, 50, 0)	466	121	32	29.125	7.5625
(1, 50, 0.01)	439	71	45	33.769	5.4615
(5, 100, 0)	504	83	6	168	27.667
(5, 100, 0.01)	479	57	13	239.5	28.5
(2, 200, 0)	565	22	8	141.25	5.5
(2, 200, 0.01)	533	2	19	533	2
(5, 150, 0)	521	66	6	173.67	22
(5, 150, 0.01)	507	21	17	126.75	5.25

Table 4: Combining strategy signals

	AGF			COM			DHA		
	Buy	Sell	Buy-Sell	Buy	Sell	Buy-Sell	Buy	Sell	Buy-Sell
(1, 50, 0)	-2.7E-04	-0.00066	0.00039	0.0001	0.00146	-0.0013	0.0027*	-0.0009	0.00359*
(1, 50, 0.01)	-2.1E-04	-0.001	0.0008	3.6E-05	0.00152	-0.0015	0.0023*	-0.0010	0.0032*
(5, 100, 0)	0.0005	0.00037	0.00018	0.0006	0.00162	-0.0009	0.00186*	-0.0012	0.0030*
(5, 100, 0.01)	0.0006	0.00037	0.00027	0.0002	0.00199	-0.0018	0.00181	-0.0015	0.0033*
(2, 200, 0)	0.0023*	-0.001	0.0034*	0.0019	0.00055	0.0014	0.002*	-0.0006	0.0027*
(2, 200, 0.01)	0.0024*	-0.00127	0.0037*	0.0023	0.0009	0.0014	0.0023*	-0.0005	0.0029*
(5, 150, 0)	0.0005	-0.00053	0.00103	0.0011	0.003	-0.00196	0.00188*	-0.0021*	0.004*
(5, 150, 0.01)	0.00087	-0.00097	0.00185	0.0014	0.0038	-0.0025	0.00173	-0.0022*	0.0039*
Average	0.000858	-0.00059	0.00144	0.00096	0.001861	-0.000901	0.00208	-0.0012	0.0033
	GIL			STB			VNM		
(1, 50, 0)	0.0022*	0.0004	0.00176	0.00086	-0.00019	0.001058	0.0027*	0.00205	0.00065
(1, 50, 0.01)	0.00201	0.00033	0.00168	0.0014	-0.00045	0.001858	0.00265*	0.00182	0.00083
(5, 100, 0)	0.00083	0.001009	-0.0002	0.0020	0.00023	0.00178	0.0024*	0.00166	0.00074
(5, 100, 0.01)	0.00119	0.001023	0.00017	0.0025*	-0.00017	0.00267	0.0028*	0.0011	0.00168
(2, 200, 0)	0.00377*	-0.00146	0.00523*	0.0021	-0.00096	0.00306*	0.0024*	0.00036	0.00204*
(2, 200, 0.01)	0.00369*	-0.00149	0.00519*	0.00249*	-0.00071	0.00321*	0.00233*	-0.0003	0.00264*
(5, 150, 0)	0.00154	-0.0011	0.00264	0.00235*	-0.00145	0.003791*	0.00325*	-0.0011	0.00431*
(5, 150, 0.01)	0.00154	-0.00065	0.00219	0.00247	-0.00146	0.003948*	0.00323*	-0.0017	0.00491*
Average	0.0021	-0.00024	0.00233	0.002027	-0.00064	0.0027	0.00272	0.0005	0.0022

(*) Values are statistically different from zero at the 5% level of significance.

Table 5: Full sample combining signals return

The combining trading strategies is defined as: A buy (sell) signal is generated at time $t - 1$ if both the rolling AR(1) model and the corresponding technical trading rule emit buy (sell) signal based on I_{t-1} .

There are the improvement of buy signals in term of return compare with the technical trading rules but the majority of the return is statistically insignificant at 5% level for the test given in section 3. The empirical results based on out-of sample forecasts over the full sample period are reported in table 4 and 5. In table 4, in comparison with those from corresponding technical trading rules, the required number of transactions is reduced 29.19% in average.

4 Conclusions

The idea of combining signals from different trading models implicitly assumed that trader could not identify an appropriate model for different trading strategies especially in such a volatile stock market as Vietnam, but that different models were able to capture different aspects of the information for trading.

Bessembinder et. al. and Brock et. al. found the predictive ability of technical trading rules on US data where as this study put a further step on examining the combination of time series model and technical trading rules on Vietnam data. Since the objective in this study is to look for another aspects of combining trading strategies on a very young stock market, before and after the crisis in 2008, we only use some simple combination forms and on overall. These interested findings in subsamples analysis suggest that the combining of these two trading strategies might yield more favorable results. We found that there are improvements in term of return given by buy signals and the number of transactions of the combined models. However, the length of time needed to make consistent return may question these combination forms as practical investment tools.

It is apparent that this simple combined trading strategy can be improved depending on different time horizons of investment and the level of transaction costs. Other market data such as trading volume may also affect the excess returns.

Appendix

The full sample is divided into 3 periods in which the stocks move uptrend, downtrend and sideways respectively:

	Uptrend	Downtrend	Sideways
AGF	02/05/2002-27/02/2007	28/02/2007-23/02/2009	24/02/2009-17/05/2013
COM	07/08/2006-03/01/2008	04/01/2008-17/04/2009	18/04/2009-16/05/2013
DHA	14/04/2004-21/11/2007	22/11/2007-15/12/2008	16/12/2008-17/05/2013
GIL	02/01/2012-30/11/2007	03/12/2007-26/02/2009	27/02/2009-17/05/2013
STB	12/07/2006-01/06/2007	04/06/2007-03/03/2009	04/03/2009-17/05/2013
VNM	19/01/2006-24/10/2007	25/10/2007-15/04/2009	16/04/2009-17/05/2013

Table 6: Trends

Comparing tables

Buy signals returns TA												Buy signals returns TS												
	AGF	COM	DHA	GIL	STB	VNM	AR	GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	AR	GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM
(1, 50, 0)	0.00241*	0.00227	0.00196*	0.00151	0.00467*	0.00385*				0.00383*	0.00456*	0.00379*	0.00331*	0.00874*	0.00815*				0.00379*	0.00456*	0.00379*	0.00331*	0.00874*	0.00815*
(1, 50, 0.01)	0.00319*	0.0028	0.00173*	0.00178*	0.00506*	0.00423*	AR	GARCH	AR EGARCH	0.00402*	0.00292	0.00412*	0.00405*	0.00867*	0.0083*				0.00402*	0.00292	0.00412*	0.00405*	0.00867*	0.0083*
(5, 100, 0)	0.00242*	0.00235	0.00173*	0.00131	0.0048*	0.00343*				0.00279*	0.00269	0.00405*	0.00393*	0.00857*	0.0083*				0.00279*	0.00269	0.00405*	0.00393*	0.00857*	0.0083*
(5, 100, 0.01)	0.00305*	0.00217	0.00175*	0.00113	0.00625*	0.00333*																		
(2, 200, 0)	0.00243*	0.00172	0.00189*	0.00118	0.0065*	0.00312*																		
(2, 200, 0.01)	0.0026*	0.00218	0.00199*	0.00106	0.00687*	0.00311*																		
(5, 150, 0)	0.00247*	0.00218	0.00202*	0.00116	0.00651*	0.00304*																		
(5, 150, 0.01)	0.00271*	0.00193	0.00201*	0.00125	0.00651*	0.00308*																		
Average	0.00266	0.0022	0.00189	0.0013	0.00589	0.0034	Average			0.00355	0.00339	0.00399	0.00377	0.00866	0.00825				0.00355	0.00339	0.00399	0.00377	0.00866	0.00825
Sell signal returns TA												Sell signal returns TS												
	AGF	COM	DHA	GIL	STB	VNM	AR	GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	AR	GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM
(1, 50, 0)	0.00067*	0.00216	0.00083	0.00071	0.0005	0.00182	AR	GARCH	AR EGARCH	0.0001*	0.00052	-0.00017*	-0.00132*	-0.00079*	-0.00035*				0.0001*	0.00052	-0.00017*	-0.00132*	-0.00079*	-0.00035*
(1, 50, 0.01)	0.00098*	0.00369	0.00045*	0.00029*	0.00146*	0.0022*	AR	GARCH	AR EGARCH	6.40E-05*	0.00122	-0.00002*	-0.00108*	-0.00105*	-0.00084*				6.40E-05*	0.00122	-0.00002*	-0.00108*	-0.00105*	-0.00084*
(5, 100, 0)	0.00062*	0.00117	0.00116	0.00079	0.00168	0.00203*				7.51E-05*	0.00139	-0.000016*	-0.00102*	-0.00073*	-0.00084*				7.51E-05*	0.00139	-0.000016*	-0.00102*	-0.00073*	-0.00084*
(5, 100, 0.01)	0.00072*	0.00047	0.00099	0.0007	0.00034	0.00369																		
(2, 200, 0)	0.00042*	0.00055	0.00065	0.00075	0.00028	0.00551*																		
(2, 200, 0.01)	0.00053*	0.00771	0.00079*	0.00068	0.00022	0.00601*																		
(5, 150, 0)	0.00052*	0.00163	0.00016*	0.00097	0.00022	0.00484																		
(5, 150, 0.01)	0.00069*	0.00353	0.00123	0.00087	0.00022	0.00423*																		
Average	0.00064	0.00323	0.00078	0.00072	0.00062	0.00379	Average			8.1E-05	0.00104	-0.00018	-0.00114	-0.00086	-0.00067				8.1E-05	0.00104	-0.00018	-0.00114	-0.00086	-0.00067
Break-even costs with interest rate TA												Break-even costs with interest rate TS												
	AGF	COM	DHA	GIL	STB	VNM	AR	GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	AR	GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM
(1, 50, 0)	2.507%	1.808%	2.642%	1.504%	6.602%	4.647%	AR	GARCH	AR EGARCH	0.3440%	0.4608%	0.3402%	0.2263%	0.7144%	0.7283%				0.3440%	0.4608%	0.3402%	0.2263%	0.7144%	0.7283%
(1, 50, 0.01)	1.498%	1.343%	0.946%	0.698%	3.587%	3.391%	AR	GARCH	AR EGARCH	0.3651%	0.5157%	0.3694%	0.2292%	0.7739%	0.7356%				0.3651%	0.5157%	0.3694%	0.2292%	0.7739%	0.7356%
(5, 100, 0)	7.900%	7.418%	10.367%	4.940%	14.726%	20.296%				0.3573%	0.4836%	0.3659%	0.2260%	0.7429%	0.7356%				0.3573%	0.4836%	0.3659%	0.2260%	0.7429%	0.7356%
(5, 100, 0.01)	4.775%	4.233%	3.819%	1.804%	6.653%	7.276%																		
(2, 200, 0)	5.303%	6.097%	12.120%	4.353%	14.794%	28.053%																		
(2, 200, 0.01)	2.984%	5.150%	8.404%	2.400%	12.764%	9.716%																		
(5, 150, 0)	8.574%	12.256%	18.161%	5.171%	24.650%	20.172%																		
(5, 150, 0.01)	6.108%	7.645%	6.896%	2.848%	10.558%	14.873%																		
Average	4.956%	5.744%	7.919%	2.965%	11.792%	13.553%	Average			0.3555%	0.4867%	0.358%	0.2272%	0.7437%	0.7331%				0.3555%	0.4867%	0.358%	0.2272%	0.7437%	0.7331%

Table 7: Trading stats during uptrend

Buy signals returns TA													Buy signals returns TS												
	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	
(1, 50, 0)	-0.0055	-0.0010	0.0004	-0.0071	-0.0038	-0.0005	0.00075	0.00070	0.00465	0.00070	0.00070	0.00465	0.00247	0.00335	0.00350	0.00075	0.00069	0.00245	0.00069	0.00069	0.00465	0.00247	0.00335	0.00350	
(1, 50, 0.01)	-0.0052	-0.0018	0.0014	-0.0096	-0.0021	-0.0023	0.00069	0.00069	0.00463	0.00069	0.00069	0.00463	0.00245	0.00389	0.00362	0.00069	0.00069	0.00245	0.00069	0.00069	0.00463	0.00245	0.00389	0.00362	
(5, 100, 0)	-0.0033	-0.0010	-0.0134	-0.0246	-0.0039	-0.0120	0.00056	0.00070	0.00418	0.00070	0.00070	0.00418	0.00280	0.00338	0.00350	0.00056	0.00056	0.00280	0.00056	0.00056	0.00418	0.00280	0.00338	0.00350	
(5, 100, 0.01)	-0.0017	-0.0014	-0.0232	-0.0420	-0.0053	0.0045	0.00056	0.00070	0.00418	0.00056	0.00056	0.00418	0.00280	0.00338	0.00350	0.00056	0.00056	0.00280	0.00056	0.00056	0.00418	0.00280	0.00338	0.00350	
(2, 200, 0)	NaN	0.0030	-0.0296	-0.0068	-0.0035	-0.0114	0.00068	0.00068	0.00448	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	0.00068	0.00068	0.00247	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	
(2, 200, 0.01)	NaN	0.0039	NaN	0.0097	-0.0048	NaN	0.00068	0.00068	0.00448	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	0.00068	0.00068	0.00247	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	
(5, 150, 0)	-0.0059	-0.0018	NaN	-0.0038	-0.0035	-0.0057	0.00068	0.00068	0.00448	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	0.00068	0.00068	0.00247	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	
(5, 150, 0.01)	NaN	0.0008	NaN	NaN	-0.0027	NaN	0.00068	0.00068	0.00448	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	0.00068	0.00068	0.00247	0.00068	0.00068	0.00448	0.00247	0.00335	0.00350	
Average	-0.0043	8.1E-05	-0.0129	-0.01202	-0.0087	-0.00459	Average	0.00067	0.00449	0.00069	0.00449	0.00257	0.00354	0.00354	0.00354	0.00067	0.00069	0.00449	0.00067	0.00069	0.00449	0.00257	0.00354	0.00354	
Sell signal returns TA													Sell signal returns TS												
	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	
(1, 50, 0)	-0.0039	-0.0001	-0.0056	-0.0033	-0.0025	-0.0018	-0.0091	-0.0021	-0.0123	-0.0091	-0.0021	-0.0123	-0.0096	-0.0085	-0.0068	-0.0091	-0.0021	-0.0123	-0.0091	-0.0021	-0.0123	-0.0096	-0.0085	-0.0068	
(1, 50, 0.01)	-0.0040	-0.0005	-0.0055	-0.0034	-0.0024	-0.0015	-0.0089	-0.0021	-0.0121	-0.0089	-0.0021	-0.0121	-0.0099	-0.0092	-0.0069	-0.0089	-0.0021	-0.0121	-0.0089	-0.0021	-0.0121	-0.0099	-0.0092	-0.0069	
(5, 100, 0)	-0.0041	-0.0001	-0.0041	-0.0028	-0.0025	-0.0009	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	
(5, 100, 0.01)	-0.0041	-0.0001	-0.0041	-0.0028	-0.0025	-0.0010	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	
(2, 200, 0)	-0.0040	-0.0009	-0.0043	-0.0036	-0.0026	-0.0013	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	
(2, 200, 0.01)	-0.0040	-0.0007	-0.0044	-0.0036	-0.0026	-0.0013	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	
(5, 150, 0)	-0.0040	0.0001	-0.0044	-0.0036	-0.0026	-0.0013	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	
(5, 150, 0.01)	-0.0040	0.0001	-0.0042	-0.0036	-0.0022	-0.0013	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	-0.0088	-0.0022	-0.0119	-0.0088	-0.0022	-0.0119	-0.0105	-0.0092	-0.0068	
Average	-0.004	-0.0003	-0.0046	-0.00333	-0.00247	-0.00129	Average	-0.00893	-0.00213	-0.01208	-0.01001	-0.00896	-0.00686	-0.00686	-0.00686	-0.00893	-0.00213	-0.01208	-0.00893	-0.00213	-0.01208	-0.01001	-0.00896	-0.00686	
Break-even costs with interest rate TA													Break-even costs with interest rate TS												
	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM	
(1, 50, 0)	-8.62%	-0.46%	-12.82%	-6.79%	-4.40%	-1.96%	-0.99%	-0.12%	-1.14%	-0.99%	-0.12%	-1.14%	-0.87%	-0.68%	-0.42%	-0.99%	-0.99%	-0.87%	-0.99%	-0.12%	-1.14%	-0.87%	-0.68%	-0.42%	
(1, 50, 0.01)	-6.15%	-0.52%	-10.93%	-5.05%	-2.44%	-1.31%	-0.99%	-0.12%	-1.12%	-0.99%	-0.12%	-1.12%	-0.90%	-0.72%	-0.42%	-0.99%	-0.99%	-0.90%	-0.99%	-0.12%	-1.12%	-0.90%	-0.72%	-0.42%	
(5, 100, 0)	-65.49%	-1.44%	-22.75%	-27.00%	-10.65%	-5.49%	-0.97%	-0.12%	-1.10%	-0.97%	-0.12%	-1.10%	-0.88%	-0.70%	-0.42%	-0.97%	-0.97%	-0.88%	-0.97%	-0.12%	-1.10%	-0.88%	-0.70%	-0.42%	
(5, 100, 0.01)	-27.49%	-0.77%	-10.18%	-26.23%	-8.46%	-2.78%	-0.97%	-0.12%	-1.10%	-0.97%	-0.12%	-1.10%	-0.88%	-0.70%	-0.42%	-0.97%	-0.97%	-0.88%	-0.97%	-0.12%	-1.10%	-0.88%	-0.70%	-0.42%	
(2, 200, 0)	-196.0%	-0.88%	-37.85%	-53.86%	-10.49%	-22.69%	-0.88%	-0.12%	-1.09%	-0.88%	-0.12%	-1.09%	-0.88%	-0.70%	-0.42%	-0.88%	-0.88%	-0.88%	-0.88%	-0.12%	-1.09%	-0.88%	-0.70%	-0.42%	
(2, 200, 0.01)	-196.0%	-0.49%	-37.18%	-53.90%	-7.51%	-44.23%	-0.49%	-0.12%	-1.08%	-0.49%	-0.12%	-1.08%	-0.88%	-0.70%	-0.42%	-0.49%	-0.49%	-0.88%	-0.49%	-0.12%	-1.08%	-0.88%	-0.70%	-0.42%	
(5, 150, 0)	-65.40%	-0.98%	-113.5%	-53.90%	-12.88%	-15.13%	-0.98%	-0.12%	-1.08%	-0.98%	-0.12%	-1.08%	-0.88%	-0.70%	-0.42%	-0.98%	-0.98%	-0.88%	-0.98%	-0.12%	-1.08%	-0.88%	-0.70%	-0.42%	
(5, 150, 0.01)	-64.42%	0.14%	-106.5%	-104.69%	-5.01%	-22.70%	0.14%	-0.12%	-1.07%	0.14%	-0.12%	-1.07%	-0.88%	-0.70%	-0.42%	0.14%	-0.12%	-1.07%	-0.88%	-0.12%	-1.07%	-0.88%	-0.70%	-0.42%	
Average	-78.7%	-0.674%	-44.0%	-39.062%	-7.731%	-14.536%	Average	-0.98%	-0.12%	-1.12%	-0.88%	-0.70%	-0.88%	-0.70%	-0.42%	-0.98%	-0.12%	-1.12%	-0.98%	-0.12%	-1.12%	-0.88%	-0.70%	-0.42%	

Table 8: Trading stats during downtrend

Table 9: Trading stats during sideways

Buy signals returns TA												Buy signals returns TS											
	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM								
(1, 50, 0)	0.0014	-0.0002	0.00166	0.000841	0.002102*	0.00144*	0.000841	0.002899*	0.00171*	0.00263	-0.002	0.00191	0.00298*	0.00378*	0.00437*								
(1, 50, 0.01)	0.00206	-0.0005	0.00187	1.85E-05	0.002899*	0.00171*	1.85E-05	0.002899*	0.00171*	0.00152	-0.0022	0.00155	0.00282*	0.00378*	0.00415*								
(5, 100, 0)	0.00193	0.00078	0.00144	0.001702	0.002252*	0.00164*	0.001702	0.002252*	0.00164*	0.00254	-0.0022	0.00168	0.00282*	0.00377*	0.00415*								
(5, 100, 0.01)	0.00225	0.00055	0.00128	0.001555	0.00287	0.00179	0.001555	0.00287	0.00179	0.00254	-0.0022	0.00168	0.00282*	0.00377*	0.00415*								
(2, 200, 0)	0.00165	0.00034	0.00018	0.001297	0.001823	0.0016	0.001297	0.001823	0.0016	0.00263	-0.002	0.00191	0.00298*	0.00378*	0.00437*								
(2, 200, 0.01)	0.00169	0.00024	0.00172	0.00135	0.001848	0.00159	0.00135	0.001848	0.00159	0.00152	-0.0022	0.00155	0.00282*	0.00378*	0.00415*								
(5, 150, 0)	0.00161	0.00038	0.00159	0.001785	0.00243*	0.00178*	0.001785	0.00243*	0.00178*	0.00254	-0.0022	0.00168	0.00282*	0.00377*	0.00415*								
(5, 150, 0.01)	0.00182	0.00059	0.00128	0.001836	0.002317*	0.00171*	0.001836	0.002317*	0.00171*	0.00254	-0.0022	0.00168	0.00282*	0.00377*	0.00415*								
Average	0.0018	0.00028	0.00158	0.001298	0.002318	0.00166	Average	0.00223	-0.0021	0.00172	0.00288	0.00378	0.00423										
Sell signal returns TA												Sell signal returns TS											
	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM								
(1, 50, 0)	0.00117	0.00316	-0.0011	0.00214	0.000178	0.00359	0.00117	0.00316	-0.0011	5.73E-05	0.00433	-0.0021	4.58E-05	0.00023	0.00026								
(1, 50, 0.01)	0.00131	0.00385	-0.0013	0.002537	6.13E-06*	0.00349	0.00131	0.00385	-0.0013	8.91E-04	0.00461	-0.0021	0.00018	0.00026	0.00026								
(5, 100, 0)	0.00059	0.00187	-0.001	0.000537	-9.59E-06	0.00331	0.00059	0.00187	-0.001	1.74E-04	0.00461	-0.0021	0.00018	0.00026	0.00026								
(5, 100, 0.01)	0.00039	0.00232	-0.0013	0.000911	-0.0002*	0.00312	0.00039	0.00232	-0.0013	1.74E-04	0.00461	-0.0021	0.00018	0.00026	0.00026								
(2, 200, 0)	0.00077	0.00289	-0.0011	0.001328	0.000347	0.00718	0.00077	0.00289	-0.0011	5.73E-05	0.00433	-0.0021	4.58E-05	0.00023	0.00026								
(2, 200, 0.01)	0.0006	0.00265	-0.0009	0.001596	0.000465	0.0084	0.0006	0.00265	-0.0009	8.91E-04	0.00461	-0.0021	0.00018	0.00026	0.00026								
(5, 150, 0)	0.00082	0.00276	-0.0012	0.000406	-0.00027*	0.00317	0.00082	0.00276	-0.0012	1.74E-04	0.00461	-0.0021	0.00018	0.00026	0.00026								
(5, 150, 0.01)	0.00071	0.0025	-0.0014	0.00081	-0.00016	0.00561	0.00071	0.0025	-0.0014	1.74E-04	0.00461	-0.0021	0.00018	0.00026	0.00026								
Average	0.0008	0.00275	-0.0011	0.001283	4.5E-05	0.00473	Average	0.00037	0.00451	-0.0021	0.00014	-0.0019	0.00025										
Break-even costs with interest rate TA												Break-even costs with interest rate TS											
	AGF	COM	DHA	GIL	STB	VNM	AR	AR GARCH	AR EGARCH	AGF	COM	DHA	GIL	STB	VNM								
(1, 50, 0)	1.283%	0.879%	0.031%	1.460%	1.937%	2.850%	1.283%	0.879%	0.031%	0.2407%	0.2713%	-0.004%	0.2914%	0.2204%	0.4093%								
(1, 50, 0.01)	0.892%	0.449%	-0.012%	0.600%	1.405%	1.503%	0.892%	0.449%	-0.012%	0.2492%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
(5, 100, 0)	7.515%	3.091%	0.065%	8.284%	5.596%	12.695%	7.515%	3.091%	0.065%	0.2454%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
(5, 100, 0.01)	2.679%	1.483%	-0.788%	3.774%	3.469%	4.716%	2.679%	1.483%	-0.788%	0.2454%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
(2, 200, 0)	6.650%	3.544%	0.107%	6.572%	5.084%	9.924%	6.650%	3.544%	0.107%	0.2454%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
(2, 200, 0.01)	2.837%	1.532%	0.298%	3.423%	3.902%	5.359%	2.837%	1.532%	0.298%	0.2454%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
(5, 150, 0)	6.015%	4.667%	0.063%	11.069%	9.026%	16.725%	6.015%	4.667%	0.063%	0.2454%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
(5, 150, 0.01)	3.351%	2.012%	-0.838%	6.323%	5.132%	5.432%	3.351%	2.012%	-0.838%	0.2454%	0.2697%	-0.004%	0.2940%	0.2237%	0.3856%								
Average	3.903%	2.207%	-0.134%	5.188%	4.444%	7.400%	Average	0.2451%	0.2702%	-0.004%	0.2932%	0.2226%	0.3935%										

Table 10: Trading stats during sideways

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