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Profitability of Oscillators used in Technical Analysis for Financial Market

Mohd Naved[1] and Prabhat Srivastava[2]

[1]Noida International University kh-1/131, Building No-4, Mata Wali Street Rajput Mohalla, Ghonda, Delhi-11005
[2]SBM, Noida International University CRS, Noida International University Gautam Buddh Nagar, UP, Indi
E-mail: [1]mohdnavedresearch@gmail.com, [2]dir.sbm@niu.ac.in

Abstract—*This research paper aim to examine the profitability of various kinds of oscillator used in technical analysis on market index of NSE (National Stock Exchange) S & P CNX Nifty 50 During 2004-2014. We have selected the most commonly used three oscillators i.e., Stochastic oscillator, RSI Oscillator and Commodity Channel Index (CCI). The results clearly express that CCI outperform the remaining two oscillators in terms of profitability for S&P CNX NIFTY50 Index.*

1. TECHNICAL ANALYSIS

Technical analysis uses historical data for prediction of future prices, for better visualization of data, it is plotted in the form of a chart. Technical analysis is very commonly used by practitioners for forecasting on stock, commodity, and foreign exchange markets. In the academic world, profitability of technical analysis is still a myth, although a lot of research is done on the topic in the last two decades, but most of the research is done using the very long term historical data for Dow Jones Industrial Average (DJIA).

Technical analysis is based on two basis assumptions – (1) Price Discount Everything – It means that the current price of a product has all information in it, thus there is no need to analysis anything else apart from price action. (2) History Repeat itself – It means that prices move in trend, and same trend and patterns keep on repeating itself. This is the reason why pattern analysis is one of the important pillars in technical analysis. If this assumption won't stand good, then there is no use of analyzing the historical data for future price predictions.

The most famous work on technical analysis is done by Murphy (1999) in his book, serving as the gold standard reference today. Various tools used in technical analysis, including chart construction, price patterns, various forms of moving average and the oscillator, and Dow Theory has been discussed in detail in the book. Murphy also addressed the issue of changes in technology and its increasing use in technical analysis.

Technical analysis can be divided into two forms (1) - Pattern/Candle analysis (2) – Analysis using indicators. Charting involves the visual identification of patterns in the historical data, on the basis of these patterns future price movement can be predicted. Pattern analysis is very subjective analysis and its effectiveness solely depend on the skills and experience of the person using it. On the other hand, technical indicators such as moving averages or oscillators uses mathematical formulas on the price, volume and open interest to generate buy and sell signals. Trading based on technical indicators is very systematic and disciplined approach for price prediction.

2. LITERATURE REVIEW

Menkhoff (2010) survey of fund managers clearly shows that technical analysis is the most important form of analysis for forecasting for short term. For US equity market, Marshall et al. (2008) study on 7846 technical trading rules tested on SPDR (Standard & Poor's Depositary Receipts) expressed the opinion that technical analysis is not profitable. Tanaka-Yamakawi and Tokuoka (2007), analyzed the effectiveness of technical indicators on Tick data on eight stocks traded at NYSE (New York Stock Exchange). The results show that moving average based rules were convincingly profitable and combination of indicators make more accurate signals than any individual indicator. Literature review clearly expressed a mixed opinion about the effectiveness and profitability of technical analysis.

3. OSCILLATORS

Oscillators are widely used as a tool of technical analysis, they are popular mainly because of their leading signal generating ability, being as leading indicators they don't lag behind the price action. They are most profitable in a sideways market, in contrast to trend following indicator like moving average, which is more profitable in a trending market. Oscillators take the form of lines drawn below the price plot and usually moves in a pre-defined range.

Oscillators are used for generating trading signals by using the direction and value of oscillators. The value of the oscillators indicate the strength of trend. If the value of oscillator rises, the price increases and it gains momentum. Oscillators are

also used to find out the overbought and oversold zone, if the prices rises too quickly the oscillator reaches to a level at which it is considered overbought. Conversely, if the prices decreases too sharply, the oscillator reaches to a level at which it is considered oversold.

4. STOCHASTIC OSCILLATOR

Stochastic Osciallator is a momentum oscillator developed by Dr. George C. Lane in late in 1950s. It works by comparing the current price with a defined price range. Stochastic follow the momentum and not the price, and because momentum changes its direction before a change in price, thus it gives signal earlier than any other price following indicator. Its values ranges between 0 to 100.

Calculation

%K = (Current Close - Lowest Low)/(Highest High - Lowest Low) * 100

%D = n-day SMA of %K

Where :

Lowest Low = lowest low for the given period

Highest High = highest high for the given period

%K is multiplied by 100 to move the decimal point two places

SMA is Simple Moving Average of n period

5. THREE TYPES OF STOCHASTIC

Fast Stochastic – It is the standard stochastic with above formula without any modification.

Slow Stochastic – In this variation of stochastic we use the same lines smoothed by computing moving averages of their values, thus it generate less number of signals for trading.

Full Stochastic – In this type of stochastic K% is computed in same manner as above, then we smooth the K% by calculating its moving average thus getting k%(Full). At last we draw another line D% (full), which is simple moving average of k%(full) for a specific period. For our testing, we will use full stochastic with following trading rule.

Trading Rule

Buy: Whenever K%(Full) is greater than D%(full)

Sell:Whenever K%(Full) is less than D%(full)

Short Sell:Whenever K%(Full) is less than D%(full)

Buy to cover: Whenever K%(Full) is greater than D% (full)

6. RSI (RELATIVE STRENTH INDEX)

RSI was developed by Welles Wilder, it is a technical indicator which calculate the rate of increase or decrease in price of a product for a period of time. Its value ranges between 0 to 100, and like stochastic value above a certain high level e.g. 80 denotes overbought area and conversely below 20 denotes an oversold area. Like all other oscillators, trading signal can be generated using the direction of RSI, or another way of generating signal is crossover of RSI with its own moving average.

RSI = 100 - (100/(1+ RS))

Where:

RS= (average daily price increase / average daily price decrease)

Calculation:

Trading Rule

Buy: Whenever RSI is greater than SMA of RSI

Sell: Whenever RSI is less than SMA of RSI

Short Sell: Whenever RSI is less than SMA of RSI

Buy to cover: Whenever RSI is greater than SMA of RSI

7. COMMODITY CHANNEL INDEX (CCI)

Commodity Channel index was introduced by Donald Lambert in 1980.Although the name of this indicator relate it with commodity trading, as initially it was developed for commodity trading. But now a days it is extensively used by traders for all product types including stocks, forex and commmodities.

Calculation

CCI = (price - simple moving average) / (0.015 * standard deviation of the price)

Trading Rule

Buy: Whenever CCI is greater than 0.

Sell: Whenever CCI is less than 0.

Short Sell : Whenever CCI is less than 0.

Buy to cover : Whenever CCI is greater than 0.

8. TEST RESULTS

Results of Stochastic Oscillator

We have tested Stochastic trading rules by using every combination with K% values from 7 to 21, D% values from 3 to 7 and SMA of K% with values from 3 to 7. So it concluded with total 300 different tests for this trading rule on 11 years of S&P CNX Nifty 50 data from 1st Jan. 2004 to 31st Dec. 2014. Detail analysis is available on **Table-1** for all 300 tests.

Table 1: Top 100 Results of Stochastic Oscillator

Rank	Net Profit	Total Trades	Trade Profit/Loss	Avg. Profit/ Avg.Loss	K%	D%	MA
1	6979.10	321	158/163	1.67	21	3	3
2	6147.45	295	146/149	1.55	19	3	4
3	6112.90	325	156/169	1.63	20	3	3
4	5841.25	284	139/145	1.57	15	4	3
5	5841.25	331	159/172	1.59	17	3	3
6	5796.65	291	141/150	1.59	13	4	3
7	5718.15	335	160/175	1.58	18	3	3
8	5618.50	285	147/138	1.41	21	3	4
9	5565.40	296	143/153	1.57	12	4	3
10	5565.15	287	141/146	1.51	14	4	3
11	5473.35	331	155/176	1.61	19	3	3
12	5449.30	298	147/151	1.48	18	3	4
13	5391.95	278	135/143	1.56	21	4	3
14	5372.10	334	160/174	1.55	16	3	3
15	5310.25	300	149/151	1.45	15	3	4
16	5308.00	271	134/137	1.50	20	4	3
17	5228.75	301	149/152	1.48	7	4	3
18	5222.25	296	144/152	1.54	8	4	3
19	5186.55	273	131/142	1.57	18	4	3
20	5109.65	302	141/161	1.62	11	4	3
21	5070.20	295	142/153	1.54	9	4	3
22	4998.05	279	133/146	1.57	16	4	3
23	4984.60	296	145/151	1.45	17	3	4
24	4980.75	285	140/145	1.48	20	3	4
25	4953.55	303	140/163	1.64	10	4	3
26	4864.80	301	147/154	1.47	13	3	4
27	4847.05	329	161/168	1.45	13	3	3
28	4810.45	259	120/139	1.66	19	3	5
29	4796.55	309	158/151	1.34	9	3	4
30	4763.15	335	162/173	1.47	11	3	3
31	4735.40	277	134/143	1.49	19	4	3
32	4689.65	310	155/155	1.36	11	3	4
33	4635.00	253	122/131	1.53	20	3	5
34	4624.80	338	162/176	1.48	12	3	3
35	4622.00	304	146/158	1.48	14	3	4
36	4580.40	276	133/143	1.49	17	4	3
37	4573.10	275	143/132	1.28	7	5	3
38	4540.80	314	158/156	1.35	8	3	4
39	4516.65	245	115/130	1.58	20	4	4
40	4469.55	281	133/148	1.53	8	3	5
41	4379.10	302	152/150	1.34	12	3	4
42	4379.10	304	145/159	1.47	16	3	4
43	4334.20	332	154/178	1.53	15	3	3
44	4291.40	245	112/133	1.64	19	4	4
45	4273.80	255	127/128	1.39	7	4	5
46	4177.75	281	138/143	1.39	9	3	5
47	4157.70	254	116/138	1.60	13	4	4
48	4124.40	274	129/145	1.50	13	3	5
49	4099.95	245	114/131	1.55	21	4	4
50	4072.95	261	128/133	1.39	9	4	4
51	4036.85	245	120/125	1.41	20	6	3
52	4013.35	261	119/142	1.60	18	3	5
53	4011.90	245	120/125	1.41	21	6	3
54	4006.50	268	127/141	1.48	17	3	5
55	3998.75	339	163/176	1.41	9	3	3

56	3997.90	257	123/134	1.47	21	3	5
57	3951.60	243	111/132	1.60	18	4	4
58	3925.65	244	115/129	1.51	19	6	3
59	3915.45	280	131/149	1.50	7	3	5
60	3876.10	236	108/128	1.60	20	3	6
61	3870.85	334	157/177	1.45	14	3	3
62	3864.75	278	131/147	1.46	12	3	5
63	3830.10	271	128/143	1.46	15	3	5
64	3792.70	250	115/135	1.55	14	4	4
65	3787.65	274	131/143	1.44	7	4	4
66	3783.60	278	131/147	1.45	11	3	5
67	3753.70	346	165/181	1.41	10	3	3
68	3753.60	235	106/129	1.61	21	3	6
69	3733.75	265	124/141	1.49	16	3	5
70	3688.70	206	100/106	1.43	15	4	7
71	3685.70	274	130/144	1.43	14	3	5
72	3648.05	348	170/178	1.34	8	3	3
73	3562.05	219	105/114	1.44	15	4	6
74	3557.90	224	102/122	1.60	19	3	7
75	3555.95	240	106/134	1.65	18	3	6
76	3541.75	228	107/121	1.49	21	4	5
77	3484.31	252	123/129	1.36	8	4	5
78	3460.26	264	119/145	1.54	11	4	4
79	3457.05	259	120/139	1.48	12	4	4
80	3445.30	220	103/117	1.49	16	4	6
81	3425.00	276	141/135	1.22	8	5	3
82	3414.25	246	114/132	1.50	18	6	3
83	3407.80	211	103/108	1.38	19	6	4
84	3378.75	318	152/166	1.37	10	3	4
85	3369.60	267	128/139	1.39	8	4	4
86	3362.70	217	103/114	1.44	18	4	6
87	3352.25	258	122/136	1.42	7	3	6
88	3349.05	246	113/133	1.50	16	3	6
89	3328.90	246	111/135	1.54	15	4	4
90	3306.50	206	99/107	1.40	14	4	7
91	3272.55	278	131/147	1.40	10	3	5
92	3263.45	207	95/112	1.54	21	6	4
93	3258.95	245	127/118	1.19	7	5	4
94	3257.56	254	122/132	1.38	9	3	6
95	3204.45	210	99/111	1.45	20	6	4
96	3191.05	238	106/132	1.60	19	3	6
97	3142.45	242	108/134	1.56	17	3	6
98	3132.05	218	101/117	1.48	17	4	6
99	3104.20	230	104/126	1.53	19	4	5
100	3100.06	252	121/131	1.37	8	3	6

From the results it is evident that best performance of stochastic is achieved for S&P CNX Nifty50 if values of %K period , %D period and SMA period is taken as 21, 3 and 3 respectively, generating a profit of 6979 points, with total 321 trades, profitable trades 158, unprofitable trades 163 and thus giving an accuracy of 49.22% in total trades. This return is 9.01% higher than buy-and-hold profit for same duration. Average profit made by these systems is 2613 points, which is 59.18% lower than buy-and-hold profit of 6402. Average number of trades is 238, with highest number of trades 348 for system # 72, while lowest number of trade is 167 for system# 146. As far as average profit by average loss ratio is concern, highest value of 1.67 is achieved by system#1, surprizingly it is the system with maximum profit , average value is 1.36 for all the systems.

Interesting to note from the test results that average profit from all the results with a high period of D% (5 and 6) and moving average (5,6 and 7) is less than average profit of total tests, clearing indicating a favorable position for the use of lower time frame moving average with low period of %D for stochastic. As per the results, a value of 4 or 3 is recommonded for maximising the profitability with this trading rule in S&P CNX Nifty50. In contrast to D% and moving average, the changes in K% period don't have that much effect on profitability, profit increased with increase in

the period of k% with maximum profit with a period of 21 (which is highest period in our testing range).

9. RESULTS OF RSI OSCILLATOR

We have tested RSI trading rules by using every combination with RSI Period from 7 to 21 and SMA of RSI with values from 3 to 7, so it concluded with total 70 different tests for this trading rule on 11 years of S&P CNX Nifty 50 data from 1st Jan. 2004 to 31st Dec. 2014. Detail analysis is available on **Table-2** for all 75 tests.

Table 2: Results of RSI Oscillator

Rank	Net Profit	Total Trades	Trade Profit/Loss	Avg. Profit/Avg. Loss	RSI	MA
1	7031.65	390	185/205	1.72	20	4
2	7024.80	385	184/201	1.70	21	4
3	6710.95	465	221/244	1.62	21	3
4	6636.45	465	221/244	1.61	20	3
5	6620.65	466	221/245	1.62	19	3
6	6476.75	392	184/208	1.70	19	4
7	6448.85	469	222/247	1.60	16	3
8	6426.55	467	221/246	1.60	18	3
9	6406.40	303	146/157	1.70	21	6
10	6387.75	393	184/209	1.70	18	4
11	6375.40	467	221/246	1.60	17	3
12	6367.05	471	222/249	1.60	15	3
13	6271.25	475	224/251	1.59	14	3
14	6259.30	396	185/211	1.68	17	4
15	6211.55	419	196/223	1.66	7	4
16	6177.95	313	149/164	1.68	16	6
17	6141.15	361	169/192	1.68	7	5
18	6128.00	399	186/213	1.67	16	4
19	6034.25	308	147/161	1.66	18	6
20	6032.35	480	223/257	1.61	12	3
21	6001.95	406	186/220	1.70	11	4
22	5959.95	411	190/221	1.66	9	4
23	5956.65	480	223/257	1.60	13	3
24	5951.15	409	189/220	1.66	10	4
25	5935.80	353	163/190	1.70	9	5
26	5930.50	338	158/180	1.68	20	5
27	5896.50	404	185/219	1.70	12	4
28	5895.90	309	149/160	1.62	20	6
29	5889.05	355	164/191	1.69	8	5
30	5887.85	482	224/258	1.59	11	3
31	5877.65	313	149/164	1.65	17	6
32	5874.45	414	191/223	1.66	8	4
33	5870.35	354	162/192	1.73	10	5
34	5865.10	307	147/160	1.63	19	6
35	5859.05	315	149/166	1.66	15	6
36	5831.90	344	158/186	1.72	18	5
37	5828.30	404	184/220	1.70	13	4
38	5784.15	347	158/189	1.74	15	5
39	5762.50	485	225/260	1.58	10	3
40	5761.15	490	224/266	1.62	8	3
41	5754.95	403	183/220	1.71	15	4
42	5663.95	345	157/188	1.72	17	5
43	5644.90	341	158/183	1.67	19	5
44	5644.35	497	228/269	1.60	7	3
45	5591.20	407	183/224	1.72	14	4
46	5588.40	487	224/263	1.59	9	3
47	5565.30	347	158/189	1.71	16	5
48	5563.00	325	147/178	1.76	12	6
49	5485.50	336	155/181	1.67	21	5

50	5365.70	350	159/191	1.69	14	5
51	5353.05	354	160/194	1.70	11	5
52	5299.60	356	162/194	1.68	12	5
53	5280.05	321	148/173	1.67	14	6
54	5187.45	322	147/175	1.69	13	6
55	5176.30	330	147/183	1.76	11	6
56	5152.95	337	147/190	1.81	10	6
57	5084.80	353	158/195	1.70	13	5
58	4836.70	346	157/189	1.65	7	6
59	4732.70	295	134/161	1.68	12	7
60	4659.30	285	131/154	1.64	14	7
61	4639.15	340	149/191	1.73	8	6
62	4638.95	284	128/156	1.70	16	7
63	4604.40	342	147/195	1.79	9	6
64	4590.95	291	131/160	1.69	13	7
65	4502.10	279	127/152	1.66	17	7
66	4470.50	286	131/155	1.63	15	7
67	4467.35	314	137/177	1.75	7	7
68	4392.25	300	136/164	1.64	10	7
69	4333.45	277	127/150	1.63	21	7
70	4313.45	278	126/152	1.65	19	7
71	4310.00	299	137/162	1.60	11	7
72	4305.50	279	128/151	1.62	20	7
73	4244.40	308	134/174	1.74	9	7
74	4213.60	279	127/152	1.62	18	7
75	3657.80	311	133/178	1.71	8	7

From the results it is evident that best performance of RSI is achieved for S&P CNX Nifty50 if values of RSI and SMA period is taken as 20 and 4 respectively, generating a profit of 7031 points, with total 390 trades, profitable trades 185, unprofitable trades 205 and thus giving an accuracy of 47.43% in total trades. This return is 9.82% higher than buy-and-hold profit for same duration. Average profit made by these systems is 5574 points, which is 12.93% lower than buy-and-hold profit of 6402. Average number of trades is 368, with highest number of trades 497 for system # 44, while lowest number of trade is 277 for system# 69. As far as average profit by average loss ratio is concern, highest value of 1.81 is achieved by system#56, average value is 1.67 for all the systems.

Interesting to note from the test results that lower period of moving average works best for profitability, almost all the top results in the test belong to moving average period 3 and 4, on the other hand all the results with higher period of moving average generates below average profit and thus higher period of moving average is not desirable for profit maximisation.

10. RESULTS OF CCI OSCILLATOR

We have tested CCI trading rules by using every period from 7 to 21 ,so it concluded with total 15 different tests for this trading rule on 11 years of S&P CNX Nifty 50 data from 1st Jan. 2004 to 31st Dec. 2014. Detail analysis is available on Table-3 for all 15 tests.

Table 3 : Results of CCI Oscillator

Rank	Net Profit	Trades	Trade Profit/Loss	Avg. Profit/Avg. Loss	CCI Period
1	7012.15	182	88/94	2.00	9
2	6956.25	108	45/63	2.97	21
3	6852.75	229	110/119	1.86	7
4	6778.05	172	79/93	2.17	10
5	6554.90	126	58/68	2.34	17
6	6550.55	129	60/69	2.30	16
7	6411.15	117	48/69	2.89	20
8	6410.95	135	62/73	2.21	14
9	6398.70	120	50/70	2.80	19
10	6324.05	132	59/73	2.34	15
11	6175.45	150	67/83	2.17	12
12	6127.55	142	61/81	2.39	13
13	6121.80	123	50/73	2.79	18
14	6015.55	205	98/107	1.81	8
15	6013.85	163	77/86	1.93	11

From the results it is evident that best performance of CCI is achieved for S&P CNX Nifty50 if period taken is 9 for RSI , generating a profit of 7012 points, with total 182 trades, profitable trades 88, unprofitable trades 94 and thus giving an accuracy of 48.35% in total trades. This return is 9.52% greater than buy-and-hold profit for same duration. Average profit made by these systems is 6446 points, which is 0.68% higher than buy-and-hold profit of 6402. Average number of trades is 149, with highest number of trades 229 for system # 3, while lowest number of trade is 108 for system# 2. As far as average profit by average loss ratio is concern, highest value

of 2.97 is achieved by system#2, average value is 2.33 for all the systems.

11. CONCLUSION

The test results clearly concluded that Stochastic, RSI and CCI almost generate same profitability with CCI marginally giving higher profit. In terms of average profit by all possible variations of a system, CCI outperform all the three indicators by giving average profit of 6446 points, which is 0.68% higher than buy-and-hold profit. The profitability of technical analysis clearly depend on the indicator choosen and the number of days included in the calculation of indicator used.

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