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IMPROVING THE PERFORMANCE OF THE RSI TRADING INDICATOR: A NOTE

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Abstract

Incorporating the directional movement (DM) information into the Relative Strength Index (RSI) is an uncharted area in technical analysis. This paper shows that the performance of RSI can be improved by including the information of daily highest and lowest prices. Compared to conventional RSI, higher annual returns are obtained by DRSI in the markets of Shanghai A, Dow Jones, CAC 40 and NIKKEI 225.

JEL Classification: *G14*
Keywords: *Directional Movement; Relative Strength Index; Annual Return; Market Efficiency.*

1. Introduction

The effectiveness of technical trading rules is a burgeoning research area. A plethora of nascent studies have provided support for the use of technical trading rules. For example, Brock et al. (1992) show that abnormal returns can be obtained by the simple average (MA) and trend break (TRB) rules. Wong et al. (2003) apply the Relative Strength Index (RSI) to the stock market of Singapore and arrive at a similar conclusion. Chong and Ng (2008) demonstrate that the Moving Average Convergence-Divergence (MACD) rule is profitable in the London Stock Exchange FT30 Index. More recently, Chong and Ip (2009) find that momentum trading rules are able to generate handsome returns in emerging currency markets. Tsang and Chong (2009) show that the On-

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Balance Volume (OBV) trading rule rewards investors in the stock markets of Greater China. Chong and Lam (2010) show that nonlinear trading rules are profitable in the U.S. stock market. Among the technical indicators, the Relative Strength Index (Wilder, 1978; Shik and Chong, 2007; Chong and Ng, 2008), or RSI, is one of the most popular in the market. However, conventional RSI utilizes the information of closing prices only. Other useful information such as the highest and lowest prices, are not taken into consideration. This paper attempts to improve the performance of the RSI indicator by incorporating the concept of directional movement (DM) (Wilder, 1978; Lam and Chong, 2006). Although both the concepts of RSI and directional movement have been well developed, no study has attempted to explore the synergy of combining the two aforementioned trading concepts together. This paper provides empirical evidence for such a synergy. A new indicator, known as directional RSI (DRSI), is proposed. The DRSI is applied to 14 major stock market indices worldwide. It is found that the modified RSI indicator is able to generate higher net annual returns in many of these markets.

2. The New *RSI* and Trading Rules

The *RSI* is defined as

$$RSI = 100 - \frac{100}{1 + RS} \tag{1}$$

where

$$RS = \frac{\sum_{t=1}^{n} P(t)_{(up)}}{\sum_{t=1}^{n} P(t)_{(down)}} \tag{2}$$

$\sum_{t=1}^{n} P(t)_{(up)}$ denotes the sum of magnitudes of price increases over the previous n trading days;
$\sum_{t=1}^{n} P(t)_{(down)}$ denotes the sum of magnitudes of price decreases over the previous n trading days.

We define the directional *RSI* as

$$DRSI = 100 - \frac{100}{1 + DRS} \tag{3}$$

where

$$DRS = \frac{\sum_{t=1}^{n} + DM(t)}{\sum_{t=1}^{n} - DM(t)} \tag{4}$$

$\sum_{t=1}^{n} + DM(t)$ denotes the sum of n-day $+DM$ over the previous n days;
$\sum_{t=1}^{n} - DM(t)$ denotes the sum of n-day $-DM$ over the previous n days.

The $+DM(t)$ and $-DM(t)$ are defined as

$$+DM(t) = \begin{cases} H(t) - H(t-1) & \left\{ \begin{array}{c} H(t) - H(t-1) > 0 and \\ H(t) - H(t-1) > L(t-1) - L(t) \end{array} \right\} \\ 0 & Otherwise \end{cases} \tag{5}$$

and

$$-DM(t) = \begin{cases} L(t-1) - L(t) & \left\{ \begin{array}{c} L(t-1) - L(t) > 0 and \\ L(t-1) - L(t) > H(t) - H(t-1) \end{array} \right\} \\ 0 & Otherwise \end{cases} \tag{6}$$

where $H(t)$ and $L(t)$ are the intraday high and intraday low prices at time t. In this paper, we adopt the following simple trading rules:

***RSI*:** Buy: $RSI(t-1) < 50$ and $RSI(t) \geq 50$
Sell: $RSI(t-1) \geq 50$ and $RSI(t) < 50$

***DRSI*:** Buy: $DRSI(t-1) < 50$ and $DRSI(t) \geq 50$
Sell : $DRSI(t-1) \geq 50$ and $DRSI(t) < 50$

Thus, a buy signal is generated whenever the indicator penetrates 50 from below and a sell signal is generated whenever it crosses 50 from above.

3. Data and Results

The data consist of daily intraday high, intraday low and closing prices of fourteen market indices retrieved from the DataStream. The details are shown in Table 1.

Table 1
The sample periods of the 14 stock market indices

Index	Country/Region	From	To
Shanghai A	China	1/1/1994	31/12/2007
Shanghai B	China	1/1/1995	31/12/2007
Shanghai Composite	China	1/1/1995	31/12/2007
Shenzhen A	China	1/1/1994	31/12/2007
Shenzhen B	China	1/1/1994	31/12/2007
Shenzhen Composite	China	1/1/1995	31/12/2007
Hang Seng	Hong Kong	1/1/1994	31/12/2007
NIKKEI 225	Japan	1/1/1994	31/12/2007
KOSPI	Korea	1/1/1994	31/12/2007
DOW JONES Industrials	United States	1/1/1994	31/12/2007
NASDAQ	United States	1/1/1994	31/12/2007
S&P 500	United States	1/1/1994	31/12/2007
CAC 40	France	1/1/1994	31/12/2007
FTSE 100	United Kingdom	1/1/1994	31/12/2007

We compare the annual rate of return for *RSI* and *DRSI* across different markets. Since there are approximately 250 trading days in a year, the annual rate of return is computed as follows:

$$Annual\ rate\ of\ return = \left[(1+r_1)(1+r_2)(1+r_3)...(1+r_n)\right]^{\frac{250}{T}} - 1 \tag{7}$$

where

$$1 + r_i = \frac{S(i)}{B(i)} \tag{8}$$

$S(i)$ and $B(i)$ are the selling and buying prices respectively in the ith transaction; n is the number of transactions; T is the number of trading days.

The annual returns for the *DRSI* and *RSI* are reported in Table 2. Table 3 reports the annual transaction costs (based on a round-trip transaction cost of 0.25%). Table 4 shows the net annual returns. The figures in parentheses are the numbers of transactions. Note that DRSI generates fewer transactions as compared to RSI. Short window DRSIs (5- to 10-day) generate higher net returns in developing markets, whereas higher net returns are achieved by DRSIs with longer windows (20- to 50-day) in developed markets. Observe from Table 4 that DRSI outperforms RSI in the Shanghai A-share market. In particular, the return of the 14-day DRSI in the Chinese stock market is remarkable, ranging from 20% to 30%, which overwhelmingly outperforms the 5-,

10-, 30-, and 50- day *DRSI* and also universally dominates the 14-day RSI by 4%. Since the B-share market is not as liquid as its A-share counterpart, the former is likely to be less efficient. From Table 4, the performances of both indicators are better in the B-share markets than in the A-share markets, reflecting that the B-share market is less efficient. This is against the finding of Chen et al. (2011), who conclude that the A-share market is less efficient. For the Japanese market, both *DRSI* and *RSI* fail to generate positive net returns, but the former performs slightly better. The performance of the 14-day DRSI in other markets is also impressive. It generates the highest returns in five of the fourteen indices in our sample, and performs well in the remaining nine. On average, the 14-day *DRSI* outperforms the 14-day *RSI* by 1.7%. For the Dow Jones and CAC 40, the *DRSI* generally dominates the *RSI*. For the U.K. market, the *RSI* performs slightly better.

Table 2
Annual rate of return (%) for the DRSI and RSI indicator

	Rule	Observations	5-day	10-day	14-day	20-day	30-day	50-day
Shanghai A	DRSI	3392	17.68	21.53	**23.63**	**22.07**	**14.07**	**15.80**
			(266)	(166)	(122)	(100)	(86)	(64)
	RSI		**21.64**	**21.83**	20.62	19.45	13.06	10.77
			(300)	(208)	(158)	(127)	(107)	(87)
Shanghai B	DRSI	3136	35.19	33.82	**28.77**	31.73	21.29	19.09
			(242)	(155)	(134)	(91)	(69)	(71)
	RSI		**43.07**	**34.19**	26.59	**33.75**	**24.57**	**20.71**
			(271)	(191)	(153)	(121)	(93)	(78)
Shanghai Composite	DRSI	3142	15.91	20.25	**21.54**	19.89	11.01	**16.38**
			(250)	(151)	(117)	(88)	(81)	(57)
	RSI		**21.77**	**22.29**	18.78	**21.10**	**16.52**	14.86
			(279)	(194)	(146)	(116)	(94)	(80)
Shenzhen A	DRSI	3392	21.99	18.03	**28.21**	19.76	16.20	**20.45**
			(249)	(169)	(118)	(109)	(85)	(59)
	RSI		**28.87**	**20.23**	26.14	**28.40**	**20.15**	16.91
			(305)	(223)	(159)	(105)	(94)	(79)
Shenzhen B	DRSI	3386	39.33	31.98	**30.36**	25.54	**22.68**	23.53
			(233)	(157)	(127)	(107)	(89)	(66)
	RSI		**45.31**	**34.62**	30.27	**28.33**	21.44	**27.34**
			(288)	(186)	(157)	(129)	(104)	(64)
Shenzhen Composite	DRSI	3128	26.50	21.72	**28.52**	22.09	19.04	**20.27**
			(225)	(153)	(113)	(107)	(73)	(54)
	RSI		**30.38**	**22.06**	25.51	**30.07**	**22.18**	18.07
			(278)	(199)	(150)	(99)	(92)	(73)
Hang Seng	DRSI	3457	4.39	**7.47**	10.29	9.32	**9.43**	6.56
			(269)	(189)	(162)	(138)	(103)	(82)
	RSI		**9.71**	7.06	**11.68**	**9.95**	7.59	**7.92**
			(302)	(204)	(185)	(151)	(112)	(99)

NIKKEI 225	DRSI	3449	-1.88	-0.73	-0.42	**1.92**	**1.60**	**5.40**
			(286)	(182)	(167)	(144)	(116)	(62)
	RSI		**-1.62**	**-0.37**	**-0.13**	0.85	-0.68	0.97
			(332)	(225)	(198)	(170)	(136)	(102)
KOSPI	DRSI	3439	6.56	**9.47**	**14.62**	14.22	13.43	6.01
			(273)	(188)	(146)	(111)	(92)	(73)
	RSI		**7.22**	**9.47**	11.03	**14.81**	**15.53**	**10.81**
			(310)	(207)	(190)	(141)	(112)	(81)
DOW JONES Industrials	DRSI	3573	4.44	**4.32**	6.70	**6.77**	2.72	**4.37**
			(291)	(202)	(154)	(117)	(107)	(79)
	RSI		**4.69**	4.19	**7.75**	4.08	**4.35**	2.63
			(355)	(252)	(99)	(164)	(128)	(124)
NASDAQ	DRSI	3506	5.12	6.15	11.53	9.00	10.74	8.47
			(272)	(205)	(157)	(129)	(113)	(68)
	RSI		**7.67**	**7.27**	**11.93**	**9.55**	**10.98**	**8.74**
			(318)	(218)	(188)	(149)	(114)	(78)
S&P 500	DRSI	3525	1.07	0.51	3.88	**4.95**	**4.20**	**3.53**
			(298)	(209)	(170)	(129)	(105)	(70)
	RSI		**2.56**	**1.99**	**5.51**	4.03	2.90	3.07
			(341)	(254)	(188)	(164)	(139)	(109)
CAC 40	DRSI	3542	-0.84	-2.07	**4.77**	3.86	**5.12**	6.08
			(302)	(226)	(192)	(146)	(112)	(102)
	RSI		**-0.25**	**-0.15**	3.37	**4.18**	3.79	**8.52**
			(350)	(232)	(223)	(184)	(136)	(87)
FTSE 100	DRSI	3537	-5.62	-3.55	-0.47	-0.21	0.66	0.89
			(308)	(218)	(188)	(153)	(117)	(91)
	RSI		**-1.16**	**-1.37**	**0.88**	**1.71**	**1.64**	**1.27**
			(364)	(267)	(219)	(182)	(144)	(112)

Note: Some trading days are excluded due to the incompleteness of intraday high, intraday low or closing prices information. Figures in parentheses are the numbers of transactions. The bolded value is the higher rate of return between the two indices.

Table 3
Annual transaction cost (%) for the DRSI and RSI indicator (Assuming a round trip transaction cost of 0.25%)

	Rule	Observations	5-day	10-day	14-day	20-day	30-day	50-day
Shanghai A	DRSI	3392	4.90 (266)	3.06 (166)	2.25 (122)	1.84 (100)	1.58 (86)	1.18 (64)
	RSI		5.53 (300)	3.83 (208)	2.91 (158)	2.34 (127)	1.97 (107)	1.60 (87)
Shanghai B	DRSI	3136	4.82 (242)	3.09 (155)	2.67 (134)	1.81 (91)	1.38 (69)	1.42 (71)
	RSI		5.40 (271)	3.81 (191)	3.05 (153)	2.41 (121)	1.85 (93)	1.55 (78)
Shanghai Composite	DRSI	3142	4.97 (250)	3.00 (151)	2.33 (117)	1.75 (88)	1.61 (81)	1.13 (57)
	RSI		5.55 (279)	3.86 (194)	2.90 (146)	2.31 (116)	1.87 (94)	1.59 (80)
Shenzhen A	DRSI	3392	4.59 (249)	3.11 (169)	2.17 (118)	2.01 (109)	1.57 (85)	1.09 (59)
	RSI		5.62 (305)	4.11 (223)	2.93 (159)	1.93 (105)	1.73 (94)	1.46 (79)
Shenzhen B	DRSI	3386	4.30 (233)	2.90 (157)	2.34 (127)	1.98 (107)	1.64 (89)	1.22 (66)
	RSI		5.32 (288)	3.43 (186)	2.90 (157)	2.38 (129)	1.92 (104)	1.18 (64)
Shenzhen Composite	DRSI	3128	4.50 (225)	3.06 (153)	2.26 (113)	2.14 (107)	1.46 (73)	1.08 (54)
	RSI		5.55 (278)	3.98 (199)	3.00 (150)	1.98 (99)	1.84 (92)	1.46 (73)
Hang Seng	DRSI	3457	4.86 (269)	3.42 (189)	2.93 (162)	2.49 (138)	1.86 (103)	1.48 (82)
	RSI		5.46 (302)	3.69 (204)	3.34 (185)	2.73 (151)	2.02 (112)	1.79 (99)

NIKKEI 225	DRSI	3449	5.18	3.30	3.03	2.61	2.10	1.12
			(286)	(182)	(167)	(144)	(116)	(62)
	RSI		6.02	4.08	3.59	3.08	2.46	1.85
			(332)	(225)	(198)	(170)	(136)	(102)
KOSPI	DRSI	3439	4.96	3.42	2.65	2.02	1.67	1.33
			(273)	(188)	(146)	(111)	(92)	(73)
	RSI		5.63	3.76	3.45	2.56	2.04	1.47
			(310)	(207)	(190)	(141)	(112)	(81)
DOW JONES Industrials	DRSI	3573	5.09	3.53	2.69	2.05	1.87	1.38
			(291)	(202)	(154)	(117)	(107)	(79)
	RSI		6.21	4.41	3.48	2.87	2.24	2.17
			(355)	(252)	(99)	(164)	(128)	(124)
NASDAQ	DRSI	3506	4.85	3.65	2.80	2.30	2.01	1.21
			(272)	(205)	(157)	(129)	(113)	(68)
	RSI		5.67	3.89	3.35	2.66	2.03	1.39
			(318)	(218)	(188)	(149)	(114)	(78)
S&P 500	DRSI	3525	5.28	3.71	3.01	2.29	1.86	1.24
			(298)	(209)	(170)	(129)	(105)	(70)
	RSI		6.05	4.50	3.33	2.91	2.46	1.93
			(341)	(254)	(188)	(164)	(139)	(109)
CAC 40	DRSI	3542	5.33	3.99	3.39	2.58	1.98	1.80
			(302)	(226)	(192)	(146)	(112)	(102)
	RSI		6.18	4.09	3.93	3.25	2.40	1.54
			(350)	(232)	(223)	(184)	(136)	(87)
FTSE 100	DRSI	3537	5.44	3.85	3.32	2.70	2.07	1.61
			(308)	(218)	(188)	(153)	(117)	(91)
	RSI		6.43	4.72	3.87	3.22	2.54	1.98
			(364)	(267)	(219)	(182)	(144)	(112)

Table 4
Net return (%) for the DRSI and RSI indicator

	Rule	Observations	5-day	10-day	14-day	20-day	30-day	50-day
Shanghai A	DRSI	3392	12.78	**18.47**	**21.38**	**20.23**	**12.49**	**14.62**
			(266)	(166)	(122)	(100)	(86)	(64)
	RSI		**16.11**	18.00	17.71	17.11	11.09	9.17
			(300)	(208)	(158)	(127)	(107)	(87)
Shanghai B	DRSI	3136	30.37	**30.73**	**26.10**	29.92	19.91	17.68
			(242)	(155)	(134)	(91)	(69)	(71)
	RSI		**37.67**	30.38	23.54	**31.33**	**22.71**	**19.15**
			(271)	(191)	(153)	(121)	(93)	(78)
Shanghai Composite	DRSI	3142	10.94	17.25	**19.21**	18.14	9.39	**15.24**
			(250)	(151)	(117)	(88)	(81)	(57)
	RSI		**16.22**	**18.43**	15.88	**18.79**	**14.66**	13.27
			(279)	(194)	(146)	(116)	(94)	(80)
Shenzhen A	DRSI	3392	17.40	14.92	**26.04**	17.75	14.63	**19.36**
			(249)	(169)	(118)	(109)	(85)	(59)
	RSI		**23.25**	**16.12**	23.21	**26.46**	**18.42**	15.45
			(305)	(223)	(159)	(105)	(94)	(79)
Shenzhen B	DRSI	3386	35.03	29.08	**28.02**	23.56	**21.04**	22.31
			(233)	(157)	(127)	(107)	(89)	(66)
	RSI		**40.00**	**31.18**	27.37	**25.95**	19.52	**26.16**
			(288)	(186)	(157)	(129)	(104)	(64)
Shenzhen Composite	DRSI	3128	22.00	**18.66**	**26.26**	19.95	17.58	**19.19**
			(225)	(153)	(113)	(107)	(73)	(54)
	RSI		**24.82**	18.08	22.52	**28.09**	**20.34**	16.61
			(278)	(199)	(150)	(99)	(92)	(73)
Hang Seng	DRSI	3457	-0.47	**4.05**	7.36	6.82	**7.57**	5.07
			(269)	(189)	(162)	(138)	(103)	(82)
	RSI		**4.25**	3.38	**8.34**	**7.22**	5.57	**6.13**
			(302)	(204)	(185)	(151)	(112)	(99)

NIKKEI 225	DRSI	3449	**-7.06** (286)	**-4.03** (182)	**-3.45** (167)	**-0.69** (144)	**-0.50** (116)	**4.28** (62)
	RSI		-7.64 (332)	-4.45 (225)	-3.72 (198)	-2.23 (170)	-3.14 (136)	-0.88 (102)
KOSPI	DRSI	3439	1.60 (273)	**6.06** (188)	**11.97** (146)	12.20 (111)	11.76 (92)	4.68 (73)
	RSI		**2.09** (310)	5.71 (207)	7.57 (190)	**12.25** (141)	**13.49** (112)	**9.34** (81)
DOW JONES Industrials	DRSI	3573	**-0.65** (291)	**0.78** (202)	4.01 (154)	**4.72** (117)	0.85 (107)	**2.98** (79)
	RSI		-1.52 (355)	-0.22 (252)	**4.27** (99)	1.20 (164)	**2.11** (128)	0.46 (124)
NASDAQ	DRSI	3506	0.27 (272)	2.50 (205)	**8.73** (157)	6.70 (129)	8.73 (113)	7.26 (68)
	RSI		**2.00** (318)	**3.38** (218)	8.58 (188)	**6.89** (149)	**8.95** (114)	**7.35** (78)
S&P 500	DRSI	3525	-4.22 (298)	-3.20 (209)	0.87 (170)	**2.66** (129)	**2.34** (105)	**2.29** (70)
	RSI		**-3.49** (341)	**-2.51** (254)	**2.18** (188)	1.12 (164)	0.44 (139)	1.14 (109)
CAC 40	DRSI	3542	**-6.17** (302)	-6.06 (226)	**1.38** (192)	**1.29** (146)	**3.15** (112)	4.28 (102)
	RSI		-6.42 (350)	**-4.25** (232)	-0.57 (223)	0.94 (184)	1.39 (136)	**6.98** (87)
FTSE 100	DRSI	3537	-11.06 (308)	-7.40 (218)	-3.79 (188)	-2.91 (153)	-1.40 (117)	**-0.71** (91)
	RSI		**-7.59** (364)	**-6.09** (267)	**-2.99** (219)	**-1.51** (182)	**-0.90** (144)	**-0.71** (112)

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