Revisiting the Performance of MACD and RSI Oscillators

Chong, Terence Tai-Leung and Ng, Wing-Kam and Liew, Venus Khim-Sen

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Terence Tai-Leung Chong[1]
Hong Kong Institute of Asia-Pacific Studies, The Chinese University of Hong Kong
and
Department of International Economics and Trade, Nanjing University,

Wing-Kam Ng,
Department of Economics, The Chinese University of Hong Kong

and

Venus Khim-Sen Liew
Faculty of Economics and Business, Universiti Malaysia Sarawak, Malaysia

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Abstract: Chong and Ng (2008) find that the Moving Average Convergence-Divergence (*MACD*) and Relative Strength Index (*RSI*) rules can generate excess return in the London stock exchange. This paper revisits the performance of the two trading rules in the stock markets of five other OECD countries. It is found that the *MACD*(12,26,0) and *RSI*(21,50) rules consistently generate significant abnormal returns in the Milan Comit General and the S&P/TSX Composite Index. In addition, the *RSI*(14,30/70) rule is also profitable in the Dow Jones Industrials index. The results shed some light on investors' believe in these two technical indicators in different developed markets.

JEL Classification: F31; G15.
Keywords: Relative Strength Index; Trading Rules; Moving Average Convergence-Divergence.

[1] Corresponding author: Terence Chong, Department of Economics, The Chinese University of Hong Kong, Shatin, Hong Kong. Email: chong2064@cuhk.edu.hk. Webpage: http://www.cuhk.edu.hk/eco/staff/tlchong/tlchong3.htm.

1. Introduction

Technical analysis has been widely applied in financial markets for decades. It examines how an investor may profit from the behavior observed in financial markets. Technical analysts believe that the historical performance of stock markets is an indication of future performance, and it is possible for one to develop profitable trading rules using historical prices, charts and related statistics. Conventional studies in technical trading rules, however, seldom provide explanations as to why these rules are profitable. Recently, behavioral finance, which studies how one can use psychology and other behavioral theories to explain the behavior of investors, has become the theoretical basis for technical analysis.

Whether technical trading rules can be relied upon to make investment decisions has been controversial. A considerable number of studies have investigated the performance of technical trading analysis. Jensen and Benington (1970) indicate that past information cannot be used to predict future prices. Neftçi (1991) argues that technical analysis cannot beat the market if the underlying process is linear. Allen and Karjalainen (1999) also conclude that technical trading rules do not generate abnormal profits over the buy-and-hold strategy, especially after deducting transaction fees. More recently, Tanaka-Yamawaki and Tokuoka (2007) also report that frequently used technical indicators, such as Moving Average Convergence-Divergence (*MACD*) and Relative Strength Index (*RSI*), are not effective in forecasting various selected intra-day US stock prices.

Treynor and Ferguson (1985), however, argue that when the non-public information is considered, technical analysis can produce sizable profits. Bessembinder and Chan (1995) conclude that the moving average and trading range breakout rules outperform the buy-and-hold strategy in Asian stock markets. Sullivan et al. (1999), Gunasekarage and Power (2001), Kwon and Kish (2002) and Chong and Ng (2008) also report significant excess returns to technical trading rules. Chong and Ip (2009) show that the momentum strategy yields considerable returns in emerging currency markets. Lui and Chong (2013) use the human trader experiment approach to compare the performance of experienced and novice

traders. It is found that traders who are more knowledgeable on technical analysis significantly outperform those who are less knowledgeable.

In this paper, the profitability of the *MACD* and *RSI*, are evaluated. *MACD* was proven to be valuable tools for traders in the 1980s and *RSI* has also been popularly adopted since its introduction by Wilder in 1978 (Wilder, 1978; Stawicki, 2007; Ni and Yin, 2009). As of today, the two rules are still widely adopted as trading indicators in the market (White, 2013, Rossillo, 2013). Despite their popularity and widespread use among traders and practitioners, they have been much neglected in the academic literature (Ülkü and Prodan, 2013)[2]. As such, their empirical performance has yet to be formally analyzed. Notably, Chong and Ng (2008) apply the *MACD* and *RSI* rules to 60-year monthly data (July 1935 to January 1994) of the London Stock Exchange FT30 Index. The authors conclude that *MACD* and *RSI* can generate significant higher than buy-and-hold strategy in this market. The current study extends that spirit of Chong and Ng (2008) to investigate if such rules can generally generate excess returns for more markets other than the specific case of London Stock Exchange. To this end, stock markets of five OECD countries are considered. Our results show that the *MACD*(12,26,0) and *RSI*(21,50) rules consistently generate significant abnormal returns in the Milan Comit General and the S&P/TSX Composite Index. This is probably because the Italian stock market is less developed compared to the stock markets of other major OECD countries and is therefore relatively inefficient. In addition, the 2 briefly describes the data sets and the trading rules. Section 3 presents the empirical results and Section 4 concludes our study.

2. Data and Methodology

The daily closing prices of the Milan Comit General, S&P / TSX Composite, DAX 30, Dow Jones Industrials and Nikkei 225 from January 1976 to December 2002 are obtained from

[2] See Rossillo et al. (2013), among the few for a recent application of these technical indicators in the Spanish stock market.

DataStream[i]. The profitability of the *MACD* and *RSI* trading rules for these indices will be evaluated. The *MACD* is constructed based on exponential moving averages. It is calculated by subtracting the longer exponential moving average (*EMA*) of window length *N* from the shorter EMA of window length *M*, where the *EMA*'s is computed as follows:

$$EMA_t(N) = \left[\frac{2}{N} \times (P_t - EMA_{t-1}(N))\right] + EMA_{t-1}(N), \quad (1)$$

where $EMA_t(N)$ is the exponential moving average at time *t*, *N* is the window length of the *EMA* , and P_t is the value of index at time *t*. Two different *MACD* rules are examined:

Rule 1:

A buy signal is produced when *MACD* crosses zero from below, while a sell signal is obtained when *MACD* crosses zero from above. This trading rule is denoted as *MACD*(*N*, *M*, 0)[3].

Rule 2:

A buy signal is generated when *MACD* crosses the 9-day EMA of the *MACD* from below, while a sell signal is obtained when *MACD* crosses the 9-day EMA of the *MACD* from above. This trading rule is denoted as *MACD*(*N*, *M*, 9).

For the *RSI* oscillator, it is computed as:

[3] The *MACD*(12,26,0) is the most commonly used *MACD* (Murphy, 1999).

$$RSI_t(N) = \frac{\sum_{i=0}^{N-1}(P_{t-i} - P_{t-i-1})1\{P_{t-1} > P_{t-i-1}\}}{\sum_{i=0}^{N-1}|P_{t-i} - P_{t-i-1}|} \times 100 \ , \qquad (2)$$

where $RSI_t(N)$ is the Relative Strength Index at time *t*, and *N* is the bandwidth. $1\{\cdot\}$ is an indicator function, which equals one when the statement inside the bracket is true, and zero otherwise. $|x|$ is the absolute value of *x*. The values of the *RSI* range from 0 to 100 inclusively. A stock is considered as fairly priced if its *RSI* is at the centerline 50. Thus, whenever the *RSI* is above 50, it indicates a bullish market, while the market is considered to be bearish when the *RSI* is below 50. *RSI* may also be used to identify overbought (*RSI* > 70) and oversold (*RSI* < 30) markets. Two different RSI rules are studied in this paper:

Rule 3:

A buy signal is triggered when *RSI* crosses the centerline (RSI=50) from below, while a sell signal is obtained when *RSI* crosses the centerline from above. This trading rule is denoted as *RSI*(*N*, 50). In this paper, the *RSI*(7, 50), *RSI*(14, 50) and *RSI*(21, 50) will be examined.

Rule 4:

The fourth rule utilizes the oversold and overbought zones. When *RSI* falls below oversold zone (*RSI* < 30) and rises above 30 again, a buy signal is obtained. A sell signal is produced when the *RSI* rises above the overbought zone (*RSI* > 70) and falls below 70 again. In this paper, we study *RSI*(14, 30/70) and *RSI*(21, 30/70).

We adopt the practice of Brock et al. (1992) that whenever there is a buy or sell signal, all other signals in the next ten days are ignored. As such, the performance of *MACD* and *RSI* and the buy-and-hold return are evaluated on the basis of 10-day returns (r_t^{10}), which is computed as:

$$r_t^{10} = \log(P_{t+10}) - \log(P_t), \tag{3}$$

where P_t is the closing price on day t[4].

3. Empirical Results

3.1. Buy-and-hold

The summary statistics for 10-day returns, which are also the returns of the buy-and-hold strategy, are reported in Table 1. The mean 10-day return of the five stock market indices ranges from 0.096% (Nikkei 225 Stock Average) to 0.39% (Milan Comit General). Note that the skewness of all the five series examined is significantly negative. Moreover, the 10-day returns for these indices are strongly leptokurtic, with the strongest kurtosis value documented for the Dow Jones Industrials. These findings are in line with those of the existing literature (Gunasekarage and Power, 2001).

TABLE 1 ABOUT HERE

3.2. Trading Rules

The 10-day returns for our *MACD* and *RSI* trading rules are summarized in Tables 2A to 3F. In these tables, "N(Buy)" and "N(Sell)" in the second and third columns respectively denote the number of buy and sell signals produced during the sample period. "Buy" and "Sell" in the next two columns in each table refer to the average 10-day returns generated by the corresponding buy and sell signals. Note that a negative return from the sell signal implies a positive profit. The *t*-statistics reported in these two columns test the null hypothesis of

[4] A negative return from the sell signal implies a positive profit.

equality between the return generated by the trading rule (μ_r) and the buy-and-hold return (μ), i.e., $H_0^r: \mu_r = \mu$, where *r* denotes buy or sell. Following Brock et al. (1992), the *t*-statistic for buy or sell returns is computed as:

$$t_r = \frac{\mu_r - \mu}{\sqrt{\frac{\sigma^2}{N_r} + \frac{\sigma^2}{N}}}, \tag{4}$$

where μ is the mean 10-day return of the sample, μ_r is the mean 10-day return of buy or sell signal, and N_r is the number of buy or sell signals. σ^2 and N are the estimated variances and the number of observations of the sample respectively. "Buy>0" and "Sell>0" in the sixth and seventh columns refer to the fractions of times that the associated buy and sell signals are higher than zero. "Buy-Sell" in the last column contains the returns from buy signals less those from their sell signal counterparts. The null hypothesis of zero profit ($H_o^{buy-sell}: (\mu_b - \mu_s) = 0$) against the alternative of positive profit ($H_A^{buy-sell}: (\mu_b - \mu_s) > 0$) is tested using the following test statistic:

$$t_{buy-sell} = \frac{\mu_b - \mu_s}{\sqrt{\frac{\sigma^2}{N_b} + \frac{\sigma^2}{N_s}}}, \tag{5}$$

where μ_b and μ_s denote the mean 10-day returns of buy and sell signals respectively, whereas N_b and N_s refer to the number of the corresponding buy and sell signals.

Rule 1

Table 2A summarizes the average 10-day return from the MACD(12,26,0) rule. The *MACD*(12,26,0) rule performs well in the Milan Comit General and the S&P/TSX Composite indices. The null hypothesis of the equality between returns from market indicators and the buy-and-hold strategy is rejected at conventional significance levels. This suggests that the trading strategy outperforms the buy-and-hold strategy. The most profitable buy (sell) signal appears in the Milan Comit General index with an average 10-day return of 1.379%. Note that the buy - sell returns are significantly positive. For the S&P/TSX Composite Index, both the null hypotheses are rejected at the 5% significance level.

TABLE 2A ABOUT HERE

Rule 2

Table 2B shows the results of the *MACD*(12,26,9) rule. For Germany, the performance of this rule is far from satisfactory. The rule is unable to yield a higher profit than the buy-and-hold strategy. The buy – sell return is significantly negative at the 5% level, suggesting that investors who follow the trading signals of *MACD*(12,26,9) will suffer a negative return of 0.944% from a pair of buy and sell signals. The loss is sizeable compared to the positive buy-and-hold return of 0.249%.

TABLE 2B ABOUT HERE

Among the five series examined, the trading rules perform the worst in the DAX 30. For the remaining series, the *MACD*(12,26,9) has no predictability. As the combination of 8-day, 17-day *EMA*s and signal line crossover can produce more reliable buy signals (Pring, 2002), we also examine the *MACD*(8,17,9) rule in this paper. From Table 2C, the return from buy signals is negative for Italy. For Germany, the *MACD*(8,17,9) rule produces sell signals which yield negative returns. The buy – sell returns are also significantly negative at the 5% level for both countries.

TABLE 2C ABOUT HERE

Rule 3

From Table 3A, the *RSI*(7,50) rule generates negative returns in the Milan Comit General. The results in Table 3B indicate that the 14-day *RSI* rule has some predictability too. In general, the buy-sell values are positive, implying that the rule is profitable. In most cases, the *RSI*(14,50) rule is able to generate profits. The predictability of the trading rule for the 21-day *RSI* is reported in Table 3C. The rule beats the buy-and-hold strategy in the Milan Comit General and the S&P / TSX Composite.

TABLE 3A ABOUT HERE

TABLE 3B ABOUT HERE

TABLE 3C ABOUT HERE

Rule 4

From Table 3D, most series have negative returns under the *RSI*(7, 30/70) rule. The return in Milan Comit General is significantly negative. The loss is 1.163% from a pair of buy and sell transactions. For other countries, none of the returns is significantly higher than the buy-and-hold strategy. The *RSI*(14, 30/70) rule yields negative returns for three series. For the Milan Comit General, a pair of buy and sell transactions generate a negative return of 1.03%, while it is -0.91% for the DAX30. Note that the sell signal produces a significant loss of 1.049% for the DAX30. However, the rule slightly outperforms the buy-and-hold strategy in the Dow Jones Industrials. For all other rules, no significant return is found. The *RSI*(21, 30/70) rule generates a negative return for the Milan Comit General.

TABLE 3D ABOUT HERE

3.3 Transaction Cost

The above results are obtained in the absence of transaction costs. In this section, we relax this assumption. According to the survey of Hudson et al. (1996) on stockbrokers and stock broking divisions of major clearing banks, the minimum commission fee is at least 0.1%. When the bid-offer spreads of 0.5% and government stamp duty of 0.5% are included, the round-trip transaction cost is at least 1%.[5] They show that technical trading rules of Brock et al. (1992) do not generate excess returns in the UK market after taking a round-trip transaction cost of 1% into consideration. Mills (1997) also shows that the moving average and trading range breakout rules cannot produce returns higher than the buy-and-hold strategy when a 1% transaction cost is taken into account. Therefore, in this paper, a 1% transaction cost is included to compute the net profits from each of the trading rule[6]. We will focus on the Italian and Canadian markets, which contain the largest number of profitable trading rules. It is found that in the presence of a 1% transaction cost, the *MACD*(12,26,0) applied to these two countries are still profitable. For Milan Comit General index and S&P / TSX Composite index, the net profits of the *MACD*(12,26,0) rule are 1.021%[7] and 0.776% respectively. Moreover, the average annual return of the *RSI*(21,50) rule net of a 1% round-trip transaction cost for the Milan Comit General index is 5.069%.

4. Conclusion

The discipline of finance has been dominated by the Efficient Market Hypothesis (EMH) for four decades since the pioneering work of Fama (1970). However, the EMH is built under

[5] Due to the increasing competition among stock brokers and the introduction of internet trading, transaction costs have been reduced sharply in recent years. It is expected that the trend of this reduction in transaction cost will continue, which will provide more room for the development of technical trading rules in the future.

[6] Rouwenhorst (1998) points out that for the large and liquid stock markets in Europe, the transaction cost is less than 1%.

[7] Note that there are 75 buy signals and 79 sell signals over the 27-year period. Therefore, the annual return net of transaction cost is (1.093%-0.5%)*75/27+(0.286%-0.5%)*79/27=1.021%.

the very assumptions that investors are rational and fully informed. If technical analysis can yield abnormal returns, it implies that the EMH and its underlying assumptions fail to hold. In recent years, researchers have attempted to identify profitable trading rules resulting from patterns of human behavior. This study contributes to the existing literature of behavioral finance by reporting the profitability of two oscillators, namely the Moving Average Convergence-Divergence (*MACD*) and Relative Strength Index (*RSI*) in five major OECD markets. The two rules have been widely used by investors but their empirical performance is relatively unexplored.

This study finds that the centerline crossover of the *RSI* has predictive ability in the Italian and Canadian stock markets. In particular, the *RSI*(21,50) rule performs well in the Milan Comit General index. The *RSI*(14,30/70) rule is also profitable in the Dow Jones Industrials index. The profits are sustainable in the presence of a 1% round-trip transaction cost. These findings are in line with Chong and Ng (2008) that the *MACD* and *RSI* rules can generate significant profit for FT30. However, for the Nikkei 225 Stock Average, none of the rules can beat the buy-and-hold strategy. When the two rules of *RSI* are compared, it is found that the performance of centreline line crossover is better. Our results shed some light on investors' believe in these two technical indicators in different developed markets. The presence of trading rule profits also indicates that investors in these markets may only be boundedly rational.

Notably, Chong and Ng (2008) demonstrate that *MACD* and *RSI* rules are robust to the choice of sample. However, it is important to note that the current study finds that these rules are not robust to the choice of market. Taking these findings together, before adopting these rules, it is advisable for traders and practitioners to at least ascertain the profitability of these rules in their markets using historical data. In addition, a simulation trading portfolio could be created in order to discover the full potential of these indicators under a real situation. [8] Moreover, practitioners or academics may examine the profitability of these rules for individual shares as an extension to the spirit of this study.

[8] We thank an anonymous referee for giving us this suggestion.

References

Allen, F. and R. Karjalainen, 1999. Using genetic algorithms to find technical trading rules. *Journal of Financial Economics* 51, 245-271.

Bessembinder, H. and K. Chan, 1995. The profitability of technical rules in the Asian stock markets. *Pacific-Basin Finance Journal* 3, 257 - 284.

Brock, W., J. Lakonishok and B. LeBaron, 1992. Simple technical trading rules and the stochastic properties of stock returns. *Journal of Finance* 5, 1731-1764.

Chen, H., T. T. L. Chong and X. Duan, 2010. A principal-component approach to measuring investor sentiment. *Quantitative Finance* 10(4), 339-347.

Chong, T. T. L. and H. Ip, 2009. Do momentum-based strategies work in emerging currency markets? *Pacific-Basin Finance Journal* 17, 479-493.

Chong, T. T. L. and W. K. Ng. 2008. Technical analysis and the London stock exchange: testing the MACD and RSI rules using the FT30. *Applied Economics Letters* 15, 1111-1114.

Fama, E. F., 1970. Efficient capital market, a review of theory and empirical work. *Journal of Finance* 25, 383- 417.

Gunasekarage, A. and D. M. Power, 2001. The profitability of moving average trading rules in South Asian stock markets. *Emerging Market Review* 2, 17 - 33.

Hudson, R., M. Dempsey and K. Keasey, 1996. A note on the weak form efficiency of capital markets: The application of simple technical trading rules to UK stock prices — 1935 to 1994. *Journal of Banking and Finance* 20, 1121-1132.

Jensen, M. C. and G. A. Benington, 1970. Random walk and technical theories: some additional evidence. *Journal of Finance* 25, 469 - 482.

Kwon, K. Y. and R. J. Kish. 2002. Technical trading strategies and return predictability: NYSE. *Applied Financial Economics* 12, 639-653.

Lui, K. M. and T. T. L. Chong, 2013. Do technical analysts outperform novice traders: Experimental evidence. *Economics Bulletin* 33(4), 3080-3087.

Mills, T. C., 1997. Technical analysis and the London Stock Exchange: Testing trading rules using the FT30. *International Journal of Finance and Economics* 2, 319-331.

Murphy, J. J., 1999. *Technical Analysis of the Financial Markets: A Comprehensive Guide to Trading Methods and Applications*, New York Institute of Finance.

Neftçi, S. N., 1991. Naïve trading rules in financial markets and Wiener-Kolmogorov prediction theory: A study of "technical analysis". *Journal of Business* 64, 549-571.

Ni, H. and H. Yin. 2009. Exchange rate prediction using hybrid neural networks and trading indicators. *Neurocomputing* 72, 2815-2823.

Pring, M. J., 2002. *Momentum Explained*, Volume 1 & 2, McGraw-Hill, New York.

Rosillo, R,; D. de la Fuente and J. A. L. Brugos. 2013. Technical analysis and the Spanish stock exchange: testing the RSI, MACD, momentum and stochastic rules using Spanish market companies. *Applied Economics* 45(12), 1541 -1550.Rouwenhorst, K.G., 1998. International momentum strategies. *Journal of Finance* 53, 267-284.

Stawicki, S. P. 2007. Application of financial analysis techniques to vital sign data: a novel method of trend interpretation in the intensive care unit. *OPUS12 Scientist* 1, 14-16.

Sullivan, R., A. Timmerman and H. White, 1999. Data-snooping, technical trading rule performance and the Bootstrap, *Journal of Finance* 54, 1647-1691.

Tanaka-Yamawaki, M. and S. Tokuoka. 2007. Adaptive use of technical indicators for the prediction of intra-day stock prices. *Physica A* 383, 125-133.

Timmermann, A. and C.W.J. Granger, 2004. Efficient market hypothesis and forecasting. *International Journal of Forecasting* 20, 15– 27.

Treynor, J. L. and R. Ferguson, 1985. In defense of technical analysis. *Journal of Finance* 40, 757-773.

Ülkü, N. and E. Prodan, 2013. Drivers of technical trend-following rules' profitability in world stock markets. *International Review of Financial Analysis* 30 (2013) 214–229.

White, R. 2013. Technical Analysis Indicator That Works Turns Positive For These Stocks, *Forbes*, April 15, 2013. Available at: http://www.forbes.com/sites/greatspeculations/2013/04/15/technical-analysis-indicator-that-works-turns-positive-for-these-stocks/. Accessed: Dec 27, 2013.

Wilder, J. W. 1978. *New Concepts in Technical Trading Systems*. USA: *Trend Research.*

Table 1: Summary Statistics for 10-day Returns

Milan Comit General	76-02
Mean	0.00390
S.D.	0.04898
Skewness	-0.26120**
Kurtosis	2.2802**
S&P/TSX Composite Index	76-02
Mean	0.00282
S.D.	0.03188
Skewness	-0.93666**
Kurtosis	6.2533**
DAX 30	76-02
Mean	0.00249
S.D.	0.03883
Skewness	-0.83329**
Kurtosis	4.7095**
Dow Jones Industrials	76-02
Mean	0.00334
S.D.	0.03218
Skewness	-1.2985**
Kurtosis	12.375**
Nikkei 225 Stock Average	76-02
Mean	0.00096
S.D.	0.03656
Skewness	-0.22022**
Kurtosis	2.5055**

Note: ** indicates significance at the 5% level

Table 2A: Average 10-day Returns from *MACD*(12,26,0)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	75	79	0.01093	-0.00286	0.667	0.506	0.01379*
			(1.236)	(-1.220)			(1.746)
S&P/TSX Composite Index	72	82	0.01159**	-0.00177	0.694	0.549	0.01335**
			(2.321)	(-1.295)			(2.593)
DAX 30	78	84	0.00404	-0.00008	0.564	0.488	0.00411
			(0.350)	(-0.602)			(0.674)
Dow Jones Industrials	93	104	0.00464	0.00534	0.624	0.615	-0.00070
			(0.386)	(0.628)			(-0.152)
Nikkei 225 Stock Average	78	88	0.00457	0.00485	0.551	0.602	-0.00029
			(0.866)	(0.992)			(-0.050)

Note: ** indicates significance at the 5% level

*indicates significance at the 10% level

Table 2B: Average 10-day Returns from *MACD*(12,26,9)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	157	164	0.00367	0.00307	0.529	0.561	0.00060
			(-0.058)	(-0.215)			(0.110)
S&P/TSX Composite Index	161	162	0.00254	0.00243	0.522	0.519	0.00011
			(-0.111)	(-0.155)			(0.031)
DAX 30	168	182	-0.00201	0.00743*	0.524	0.593	-0.00944**
			(-1.484)	(1.693)			(-2.272)
Dow Jones Industrials	178	167	-0.00006	0.00436	0.545	0.527	-0.00442
			(-1.390)	(0.405)			(-1.274)
Nikkei 225 Stock Average	175	154	0.00078	-0.00088	0.566	0.513	0.00166
			(-0.064)	(-0.616)			(0.410)

Note: ** indicates significance at the 5% level

*indicates significance at the 10% level

Table 2C: Average 10-day Returns from *MACD*(8,17,9)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	194	185	-0.00272*	0.00738	0.448	0.589	-0.01010**
			(-1.857)	(0.953)			(-2.007)
S&P/TSX Composite Index	186	197	0.00424	0.00158	0.575	0.518	0.00266
			(0.599)	(-0.539)			(0.816)
DAX 30	201	190	-0.00143	0.00755*	0.512	0.621	-0.00898**
			(-1.412)	(1.770)			(-2.286)
Dow Jones Industrials	205	194	0.00242	0.00294	0.566	0.593	-0.00051
			(-0.402)	(-0.172)			(-0.160)
Nikkei 225 Stock Average	195	193	-0.00069	0.00022	0.513	0.523	-0.00090
			(-0.620)	(-0.278)			(-0.244)

Note: ** indicates significance at the 5% level

Table 3A: Average 10-day Returns from *RSI*(7, 50)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	188	199	-0.00215*	0.00668	0.463	0.558	-0.00884*
			(-1.671)	(0.791)			(-1.774)
S&P/TSX Composite Index	171	216	0.00232	0.00175	0.526	0.528	0.00057
			(-0.203)	(-0.488)			(0.176)
DAX 30	168	224	0.00123	0.00663	0.560	0.589	-0.00541
			(-0.416)	(1.571)			(-1.364)
Dow Jones Industrials	176	231	0.00312	0.00028	0.580	0.528	0.00284
			(-0.089)	(-1.422)			(0.882)
Nikkei 225 Stock Average	182	205	-0.00066	0.00135	0.549	0.556	-0.00201
			(-0.591)	(0.151)			(-0.541)

Note: *indicates significance at the 10% level

Table 3B: Average 10-day Returns from *RSI*(14, 50)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	136	129	0.00433	-0.00488**	0.515	0.442	0.00921
			(0.102)	(-2.017)			(1.530)
S&P/TSX Composite Index	128	150	0.00372	0.00069	0.539	0.5	0.00303
			(0.318)	(-0.809)			(0.791)
DAX 30	142	165	0.00427	0.00082	0.542	0.527	0.00345
			(0.540)	(-0.546)			(0.776)
Dow Jones Industrials	145	174	0.00492	0.00318	0.607	0.5	0.00174
			(0.585)	(-0.064)			(0.481)
Nikkei 225 Stock Average	144	163	0.00430	-0.00031	0.597	0.503	0.00461
			(1.084)	(-0.439)			(1.103)

Note: ** indicates significance at the 5% level

Table 3C: Average 10-day Returns from *RSI*(21, 50)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	111	104	0.01200*	-0.01069**	0.613	0.404	0.02268**
			(1.728)	(-3.014)			(3.394)
S&P/TSX Composite Index	119	111	0.00614	-0.00271*	0.546	0.450	0.00885*
			(1.127)	(-1.813)			(2.105)
DAX 30	118	126	0.00455	0.00178	0.576	0.524	0.00278
			(0.572)	(-0.204)			(0.558)
Dow Jones Industrials	119	146	0.00287	0.00153	0.597	0.541	0.00134
			(-0.160)	(-0.674)			(0.337)
Nikkei 225 Stock Average	122	121	0.00016	-0.00055	0.525	0.479	0.00071
			(-0.239)	(-0.449)			(0.151)

Note: ** indicates significance at the 5% level

*indicates significance at the 10% level

Table 3D: Average 10-day Returns from *RSI*(7, 30/70)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	189	211	-0.00504**	0.00659	0.444	0.545	-0.01163**
			(-2.475)	(0.786)			(-2.371)
S&P/TSX Composite Index	177	232	0.00179	0.00561	0.497	0.569	-0.00382
			(-0.425)	(1.311)			(-1.201)
DAX 30	187	243	0.00226	0.00268	0.540	0.527	-0.00042
			(-0.081)	(0.076)			(-0.112)
Dow Jones Industrials	192	239	0.00574	0.00217	0.557	0.552	0.00357
			(1.018)	(-0.552)			(1.143)
Nikkei 225 Stock Average	187	229	-0.00339	0.00210	0.513	0.559	-0.00549
			(-1.604)	(0.464)			(-1.523)

Note: ** indicates significance at the 5% level

Table 3E: Average 10-day Returns from *RSI*(14, 30/70)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy> 0	Sell>0	Buy-Sell
Milan Comit General	132	158	-0.00242	0.00783	0.492	0.614	-0.01025*
			(-1.468)	(0.997)			(-1.774)
S&P/TSX Composite Index	127	169	0.00569	0.00175	0.614	0.533	0.00393
			(1.003)	(-0.429)			(1.050)
DAX 30	114	167	0.00135	0.01049**	0.491	0.653	-0.00914*
			(-0.312)	(2.628)			(-1.937)
Dow Jones Industrials	111	164	0.01017**	0.00367	0.658	0.585	0.00650
			(2.217)	(0.128)			(1.643)
Nikkei 225 Stock Average	125	164	-0.00114	-0.00031	0.496	0.518	-0.00083
			(-0.636)	(-0.440)			(-0.191)

Note: ** indicates significance at the 5% level

*indicates significance at the 10% level

Table 3F: Average 10-day Returns from *RSI*(21, 30/70)

Sample period (76-02)	N(Buy)	N(Sell)	Buy	Sell	Buy>0	Sell>0	Buy-Sell
Milan Comit General	93	127	-0.00842**	0.00424	0.398	0.559	-0.01266*
			(-2.410)	(0.077)			(-1.894)
S&P/TSX Composite Index	74	127	0.00074	-0.00076	0.541	0.520	0.00150
			(-0.558)	(-1.254)			(0.322)
DAX 30	66	113	-0.00415	0.00409	0.470	0.584	-0.00824
			(-1.383)	(0.435)			(-1.370)
Dow Jones Industrials	60	110	0.00085	0.00386	0.5	0.609	-0.00301
			(-0.598)	(0.166)			(-0.583)
Nikkei 225 Stock Average	70	118	-0.00366	0.00351	0.514	0.559	-0.00717
			(-1.052)	(0.752)			(-1.301)

Note: ** indicates significance at the 5% level

*indicates significance at the 10% level

[i] In examining the predictability of *MACD* and *RSI* rules in different sub-samples, Chong and Ng (2008) demonstrate that these rules are robust to the choice of sample period.