An Empirical Comparison of Fast and Slow Stochastics

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Abstract

This paper compares the profitability of Stochastic Oscillators (STC) in 13 major stock market indices worldwide. We demonstrate, in contrast to common expectations, that the fast STC outperforms the slow STC in most markets, despite that fact that the latter can filter noisy trading signals whilst the prior cannot.

Keywords: Fast Stochastic; Slow Stochastic; Efficient Market Hypothesis.

JEL Classifications: G14, G15

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1. Introduction

Technical analysis uses historical information to predict future price movement (Ellinger, 1971). Whether technical analysis can help investors beat the market and achieve abnormal returns has long been a controversial issue. The weak-form efficient market hypothesis (Fama, 1970) implies that technical trading rules should not be able to predict abnormal returns. However, there is also evidence supporting the predictive ability of technical trading rules. For example, Brock et al. (1992) showed that the moving average rule and trading-range break-out rule both work effectively on the Dow Jones Industrial Average. Chong and Ip (2009) showed that momentum strategies generate substantial profits for investors. Recently, there has been growing interest in nonlinear trading rules. Chong and Lam (2010) and Chong et al. (2012) showed that SETAR(200) and MA(50) rules perform well in the U.S. and China.

In this paper, the performance of Stochastic Oscillators (STC) is studied. The STC was developed by George Lane in the 1950s. It is a popular technical indicator, but there is a significant lack of studies conducted on it. A special feature of the STC is that it utilizes not only the information of closing price but also the highest and lowest prices in a given period (Murphy, 1999).[2] As the fast STC often generates noisy signals, a smoothed version of the fast STC, called the slow STC, is also commonly used by investors. In this paper, the profitability of the fast STC is compared with that of the slow STC. Surprisingly, the fast STC outperformed the slow STC in most markets, despite that fact that only the latter can filter noisy trading signals.

[2] The inclusion of high, low and close prices provides a useful way of exploiting any latent Granger causality which exists in high frequency data (Fiess and MacDonald, 2002).

2. Stochastic Oscillator, %K and %D

The fast Stochastic Oscillator STC (*m,q*) consists of two parts, *m*-day %K and *q*-day %D. The *m*-day %K at time t is defined as follows:

$$FAST\%K_m(t) = \frac{CP_t - MIN(LP_t, \ldots, LP_{t-m+1})}{MAX(HP_t, \ldots, HP_{t-m+1}) - MIN(LP_t, \ldots, LP_{t-m+1})} \cdot 100, \quad (1)$$

where CP_t, LP_t and HP_t are closing, lowest and highest price in day t respectively.

The *q*-day %D of *m*-day %K is defined as follows:

$$FAST\%D_{m,q}(t) = \frac{\sum_{i=t-q+1}^{t}[CP_i - MIN(LP_i, \ldots, LP_{i-m+1})]}{\sum_{i=t-q+1}^{t}[MAX(HP_i, \ldots, HP_{i-m+1}) - MIN(LP_i, \ldots, LP_{i-m+1})]} \cdot 100. \quad (2)$$

In this paper, the 3- and 5-day versions of %D are examined. The values of %K and %D are between 0 and 100. When %K is below 20 or above 80, the stock is considered oversold and overbought respectively (Lane, 1984). Note that %K is highly sensitive. It can easily achieve the boundary values of 0 and 100. For example, when the closing price reaches the highest position in time t, %K will be equal to 100. %D serves as a smoothed version of %K as well as a signal line. The crossing of %K and %D triggers a trading signal.

As the conventional fast version STC is sensitive to sudden price movements and often generates false trading signals, a slow version of STC(*m,p,q*) was proposed. In this paper, the slow %K at time t is defined as the *p*-day simple moving average of fast %K, i.e.,

$$SLOW\%K_{m,p}(t) = \frac{\sum_{i=t-p+1}^{t} FAST\%K_m(i)}{p}. \quad (3)$$

The case where $p = 1$ corresponds to fast STC. In this paper, we let $p = 3$ for the calculation of the slow STC. The slow %D is defined as the q-day simple moving average of slow %K:

$$SLOW\%D_{m,p,q}(t) = \frac{\sum_{i=t-q+1}^{t} SLOW\%K_{m,p}(i)}{q} \quad (4)$$

The slow STC also ranges from 0 to 100.

3. Data and Methodology

The STC trading rules were applied to 13 major stock market indices. The data retrieved from Yahoo Finance consists of daily high, low and closing prices. The details are listed in Table 1.

Table 1: The thirteen market indices and their sample periods

Index	**Market**	**Sample Start**	**Sample End**
Dow Jones Industrial Average	U.S.A.	16/11/1990	12/12/2008
S&P 500	U.S.A.	16/11/1990	12/12/2008
NASDAQ	U.S.A.	16/11/1990	12/12/2008
FTSE 100	United Kingdom	3/12/1990	12/12/2008
CAC 40	France	30/11/1990	12/12/2008
DAX	Germany	26/11/1990	12/12/2008
Nikkei 225	Japan	14/6/1990	12/12/2008
Hang Seng Index	Hong Kong	3/8/1990	12/12/2008
Straits Times Index	Singapore	8/9/1999	12/12/2008
KOSPI Composite Index	South Korea	7/7/1999	12/12/2008
TSEC weighted Index	Taiwan	6/7/1999	12/12/2008
SSE Composite Index	Shanghai	4/1/2000	12/12/2008
Hang Seng China Enterprises Index	Hong Kong	22/6/1999	12/12/2008

A trading signal is generated by the crossing of %K and %D in the overbought and oversold regions.[3] The oversold region is a region where both the %K and %D are below 20. A buy signal is triggered when %K rises above %D in the oversold region. Accordingly, a buy signal at time t can be written as follows:

$$\text{Buy: } \%K(t-1) < \%D(t-1) \ \ AND \ \ \%K(t) > \%D(t)$$

where both %K and %D are below 20.

The overbought region is defined as when both %K and %D are above 80. A sell signal is triggered at time t when %K crosses below %D in the overbought region, i.e.,

$$\text{Sell: } \%K(t-1) > \%D(t-1) \ \ AND \ \ \%K(t) < \%D(t)$$

where both %K and %D are larger than 80.

Short selling was accounted for and allowed during calculation of profit. A short position is taken when a sell signal is generated. If a trading signal arises, the next trading signal indicating the same action is ignored. Since there are around 250 trading days each year, the annual rate of return can be calculated as follows:

$$\text{Annual Rate of Return} = [(1+r_1)(1+r_2)\ldots(1+r_n)]^{250/T} - 1,$$

where $(1+r_j)=S(j)/B(j)$. S(j) and B(j) are selling and buying price for the j-th

[3] All the calculations are conducted in Excel.

transaction, n is the total number of transactions, and T is the number of trading days in the sample. For simplicity, transaction costs and cost of borrowing are not included in our calculations.

4. Results and Conclusion

Table 2 reports the annual rate of return generated by the STCs.

Table 2: Returns of the STC Trading Rules

	q	m=5	m=7	m=10	m=14	m=21	m=28	BH
Dow Jones								
Fast (*p*=1)	3	1.3 (102)	7.1 (126)	4.8 (119)	5.8 (116)	2.9 (103)	3.8 (81)	6.9
	5	**5.3** (47)	7.6 (72)	***10.9*** *(82)*	**7.6** (92)	**8.3** (81)	**7.3** (63)	
Slow (*p*=3)	3	**6.2** (62)	**10.2** (86)	**8.3** (101)	**7.2** (106)	**7.0** (91)	**7.5** (77)	
	5	3.2 (29)	**8.8** (43)	7.7 (65)	2.6 (64)	3.7 (61)	1.7 (55)	
S&P 500								
Fast (*p*=1)	3	5.4 (252)	**8.8** (216)	***9.3*** *(186)*	**8.9** (164)	2.4 (121)	2.6 (93)	5.8
	5	**7.2** (132)	**9.2** (141)	**7.3** (129)	4.7 (114)	**6.3** (99)	2.8 (73)	
Slow (*p*=3)	3	**7.8** (182)	6.1 (168)	6.3 (150)	5.8 (134)	**4.4** (103)	**2.6** (85)	
	5	3.0 (88)	4.1 (108)	2.0 (107)	**5.6** (102)	5.9 (93)	**3.6** (69)	
NASDAQ								
Fast (*p*=1)	3	**10.8**(278)	***12.4****(242)*	**6.5** (188)	**2.5** (144)	**-3.6** (115)	**0.6** (93)	8.5
	5	**2.4** (144)	**9.3** (159)	**-3.1** (127)	**-1.7** (112)	**-1.6** (99)	**-0.6** (81)	
Slow (*p*=3)	3	2.8 (202)	3.3 (178)	3.2 (154)	-3.9 (128)	-5.4 (107)	-3.4 (89)	
	5	0.4 (105)	-4.3(115)	-6.1(115)	-3.9 (110)	-4.1 (99)	-3.2 (77)	
FTSE 100								
Fast (*p*=1)	3	**7.2** (268)	6.3 (239)	8.4 (209)	8.3 (157)	5.2 (123)	4.3 (98)	3.8
	5	**6.2** (145)	6.6 (147)	**9.3** (139)	**10.9** (123)	**7.5** (103)	**5.0** (80)	
Slow (*p*=3)	3	6.4 (191)	**8.3** (191)	**9.2** (165)	***11.4*** *(141)*	**6.4** (113)	**5.1** (94)	
	5	5.7 (99)	**8.3** (126)	6.7 (121)	7.1 (105)	7.4 (100)	3.3 (74)	
CAC 40								
Fast (*p*=1)	3	4.6 (245)	**6.6** (239)	***7.2*** *(201)*	**5.1** (157)	**-0.4** (119)	**1.6** (92)	3.9
	5	**2.0** (135)	**5.2** (135)	**2.7** (127)	**-0.8** (111)	**-0.7** (92)	**-0.8** (76)	
Slow (*p*=3)	3	**4.8** (185)	2.9 (179)	3.6 (161)	3.1 (135)	-0.1 (104)	0.4 (86)	
	5	-0.2(94)	0.9 (106)	-3.0 (98)	-2.6 (94)	-0.9 (90)	-1.3 (74)	
DAX								
Fast (*p*=1)	3	**4.5** (262)	***7.1*** *(238)*	**2.6** (198)	**1.9** (152)	**-1.1** (124)	-2.2 (99)	6.7
	5	-0.7 (144)	**2.0** (158)	**-3.5** (137)	**-0.2** (124)	-1.9 (99)	-0.4 (89)	
Slow (*p*=3)	3	-1.1 (182)	2.7 (186)	**2.2** (166)	-1.1 (138)	-4.9 (107)	**-1.8** (93)	
	5	**0.8** (107)	-4.2 (123)	-4.8 (119)	-4.0 (112)	**-1.4** (97)	**0.6** (89)	
Nikkei 225								
Fast (*p*=1)	3	**5.0** (263)	***9.4*** *(259)*	**8.4** (207)	6.5 (175)	4.5 (142)	**2.7** (114)	-7.3
	5	**1.4** (163)	**4.4** (169)	**6.1** (154)	**3.5** (143)	3.8 (118)	1.0 (96)	
Slow (*p*=3)	3	3.8 (199)	2.4 (203)	7.4 (183)	**7.0** (165)	**5.2** (132)	1.3 (106)	
	5	-0.2 (121)	1.6 (141)	0.7 (134)	1.8 (128)	**4.9** (110)	**1.1** (92)	

Table 2 (Continue)

	q	m=5	m=7	m=10	m=14	m=21	m=28	BH
Hang Seng Index								
Fast (*p*=1)	3	**4.2** (293)	0.0 (247)	**3.5** (211)	**-1.1** (163)	**-2.3** (116)	-6.9 (88)	*8.8*
	5	**-3.8** (151)	**1.4** (159)	**-0.6** (152)	**0.6** (127)	**-2.0** (102)	**-1.5** (82)	
Slow (*p*=3)	3	2.1 (201)	**2.5** (195)	0.6 (175)	-1.2 (152)	-3.1 (114)	**-3.9** (84)	
	5	-6.2 (104)	-2.4 (124)	-5.2 (124)	-1.9 (125)	-3.3 (92)	-2.1 (80)	
Straits Times								
Fast (*p*=1)	3	***12.4*** *(79)*	**8.7** (117)	**5.9** (99)	3.7 (79)	**-1.5** (60)	**-4.3** (48)	-2.0
	5	**3.8** (76)	**5.1** (78)	**-0.7** (64)	**-1.3** (60)	**-3.4** (46)	-11.8 (32)	
Slow (*p*=3)	3	4.0 (82)	2.3 (80)	1.4 (70)	**5.2** (70)	-4.2 (46)	-9.8 (36)	
	5	-1.3 (43)	-4.3 (46)	-4.8 (48)	-3.7 (44)	-3.5 (40)	**-10.1** (32)	
KOSPI								
Fast (*p*=1)	3	**29.9**(141)	34.9(131)	**26.7**(111)	**24.4** (92)	-4.4 (55)	-7.3 (46)	1.5
	5	**16.3** (73)	**30.2** (81)	**20.4** (75)	**7.8** (61)	**-2.7** (45)	**-5.2** (36)	
Slow (*p*=3)	3	22.7 (97)	***36.0****(107)*	17.2 (86)	14.5 (75)	**-1.7** (51)	**-2.9** (42)	
	5	6.4 (50)	9.3 (67)	11.8 (65)	-3.1 (49)	-7.7 (39)	-11.4 (34)	
TSEC								
Fast (*p*=1)	3	10.2(146)	12.5(136)	13.9(120)	**12.3** (94)	-5.9 (60)	-5.8 (51)	-6.6
	5	-3.1 (84)	**5.3** (90)	**4.9** (83)	-2.6 (64)	**-6.7** (49)	**-0.9** (45)	
Slow (*p*=3)	3	**12.9**(107)	***21.9****(113)*	**17.2**(103)	8.8 (77)	**-1.9** (58)	**-3.0** (50)	
	5	**9.6** (67)	-0.8 (71)	0.0 (70)	**3.6** (62)	-9.3 (46)	-7.9 (42)	
SSE Composite								
Fast (*p*=1)	3	**-6.0** (111)	-11.8(93)	**-3.8** (86)	**2.2** (76)	**-10.1** (56)	-13.3 (42)	*3.6*
	5	**-9.1** (70)	**2.4** (74)	**-9.6** (60)	**-6.1** (56)	-18.0(42)	-13.1 (38)	
Slow (*p*=3)	3	-9.8 (85)	**-6.0** (81)	-14.3 (70)	-7.7 (66)	-15.4 (50)	**-11.5** (42)	
	5	-11.6 (46)	-8.7 (52)	-14.2 (48)	-12.6 (44)	**-16.5** (40)	**-13.1** (36)	
Hang Seng China Enterprises								
Fast (*p*=1)	3	***13.6****(124)*	**-5.1**(108)	**9.4** (92)	**5.1** (78)	1.5 (62)	-13.7(46)	13.5
	5	-18.2 (52)	**-3.8** (66)	**-2.3** (66)	**8.8** (62)	**2.5** (52)	**-13.7**(36)	
Slow (*p*=3)	3	-0.6 (88)	-7.3 (86)	5.5 (78)	-4.2 (64)	**2.7** (62)	**-9.8** (46)	
	5	**-13.7**(40)	-13.6(44)	-6.3 (48)	3.8 (56)	-9.5 (46)	-18.3 (36)	

Notes for the interpretation of the data in Table 2 are as follows:

(i) The case where $p = 1$ corresponds to data derived from the fast STC.

(ii) Column 'q' denotes the parameter used to calculate fast and slow %D. Given the values of m, p and q, the annual rate of return was calculated.

(iii) The figures in parentheses are the numbers of transactions.

(iv) The column BH reports the buy-and-hold returns. Given the values of m and q, the bolded returns indicate the higher return value among returns generated by the fast STC and the slow STC.

(v) The highest return of the trading rule for each index is *italicized*. Note that the number of transactions generally falls when m, p or q increases. In particular, the STC with $m = 7$, 10 and 14 are more profitable. These trading rules generate considerable returns in most markets. Note that the rules do not perform well in the Hang Seng Index and SSE Composite Index.

A comparison of the performance of fast STC and slow STC is reported in Table 3. Except for the cases of the Dow Jones Industrial Average, FTSE and TSEC weighted index, the fast STC generally outperformed the slow STC. Therefore, although the slow Stochastic Oscillator can reduce the noisy signals as perceived by market participants, the performance of fast STC is better than that of slow STC in most markets.

Table 3: Comparison between returns based on fast STC and slow STC

Index	**Cases where Fast STC is Better**	**Cases where Slow STC is Better**
Dow Jones Industrial Average	5	7
S&P 500	7	5
NASDAQ	12	0
FTSE 100	6	6
CAC 40	11	1
DAX	7	5
Nikkei 225	8	4
Hang Seng Index	10	2
Straits Times Index	10	2
KOSPI Composite Index	9	3
TSEC weighted Index	5	7
SSE Composite Index	8	4
Hang Seng China Enterprises	9	3

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