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Profitability of the On-Balance Volume Indicator

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Abstract

In the literature, there is a lack of empirical studies documenting the profitability of volume-based technical indicators. This paper evaluates the profitability of the On-Balance Volume (OBV) trading rule. Our result shows that the OBV trading rule is increasingly profitable and rewards investors with notable returns in the stock markets of Greater China.

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1. Introduction

The profitability of technical trading rules has been a popular research topic since the pioneering work of Ferguson and Treynor (1985). Most of the previous studies examine the profitability of price-based trading rules, such as the variable length moving average (VMA) rule (Brock *et al*.; 1992; Hudson *et al*., 1996; Mills, 1997)[1], candle sticks (Marshall *et al*., 2008) and momentum (Chong and Ip, 2009). Results for the performance of these price-based trading rules are mixed. In some circumstances, these trading rules do reward investors with returns notably higher than the buy-and-hold benchmark.[2] A possible explanation for the mixed results is that conventional trading strategies rarely incorporate volume as a key factor in generating trading signals.[3] Volume contains useful information of market sentiment that cannot be fully reflected by price information. This paper bridges this gap by assessing the performance of the On-Balance Volume (OBV) indicator.[4] The OBV is calculated using the information of the closing price and the trading volume of a stock. Mathematically, the OBV of a stock at time t is defined as:

$$OBV_t = \begin{cases} OBV_{t-1} + V_t, C_t > C_{t-1} \\ OBV_{t-1} - V_t, C_t < C_{t-1} \end{cases},$$

and C_t and V_t are the closing price and trading volume respectively at time t. By definition, the OBV increases when prices rise and vice versa. Note that the OBV is defined recursively. To complete the definition, we define the OBV at the reference day t=0 to be zero, i.e., we let $OBV_0 = 0$. At t=1, $OBV_1 = V_1$ or $- V_1$, depending on whether the price at t=1 rises or falls relative to the price at t=0. A high value of OBV indicates good market sentiment. The OBV can also be used to predict market reversal. When OBV trends up and price trends down, or vice versa, it indicates an imminent reversal of market sentiment.

2. Data and Methodology

The daily closing prices[5] and the turnover by volume[6] of nine major stock indices around the world are retrieved from *DataStream*. The details are reported in Table 1.

[1] The VMA rule states that one should take a long position if the short-term moving average is above the long-term moving average and stay short otherwise.

[2] The existence of abnormal returns, however, contradicts the efficient market hypothesis (EMH), which purports that one cannot profit by only using past information (Fama, 1970). Fama (1991) has also agreed the extreme version of EMH that “prices reflect all available information” certainly does not stand due to positive information costs.

[3] Blume et al. (1994) have discussed the importance of trading volume.

[4] The OBV was first investigated by Woods and Vignolia in 1946. They called it "cumulative volume". Joseph Granville names it "on-balance volume" in his book *Granville's New Key to Stock Market Profits* in 1963.

[5] Unlike the closing price of an individual stock, which is in local currency units, the closing price of a stock market index is the daily closing value of the respective index, which is a unit-free measure.

[6] According to the definition in DataStream, the trading volume of an index is computed by summing up the daily total number of shares traded of the respective constituent stocks.

Table 1: The Sample Details

Index	Country/Region	From	To
CAC40	France	2/1/1992	3/4/2009
DAX[7]	Germany	1/8/2003	3/4/2009
DowJones Industrials	United States	3/4/1989	3/4/2009
FTSE100	United Kingdom	3/4/1989	3/4/2009
Hang Seng	Hong Kong	3/4/1989	3/4/2009
Shanghai A	China	4/1/1993	3/4/2009
Shanghai B	China	25/11/1994	3/4/2009
ShenzhenA	China	5/10/1992	3/4/2009
TWSE	Taiwan	3/4/1989	3/4/2009

The trading rule examined in this paper is the crossover of OBV and its moving average (OBVMA). The n-day OBVMA at time t is defined as:

$$OBVMA_t^n = \frac{1}{n}\sum_{i=1}^{n} OBV_i$$

Trading Rule

Buy at day t: $OBV_{t-1} < OBVMA_{t-1}^n$ and $OBV_t > OBVMA_t^n$

Sell at day t: $OBV_{t-1} > OBVMA_{t-1}^n$ and $OBV_t < OBVMA_t^n$

Thus, a long position is taken when OBV rises above its n-day moving average, and the position is liquidated once OBV drops below the n-day OBVMA. In this paper, the performance of the 10-, 20-, 50- and 100-day OBVMA are assessed. Short-selling is prohibited and consecutive buying actions are not allowed. To compare the returns of OBV across different markets, we calculate the annual rate of return, which is defined as

$$R_A = \left[(1+r_1)(1+r_2)(1+r_3)\cdots(1+r_m)\right]^{\frac{250}{T}} - 1,$$

where $1+r_i = \frac{S(j)}{B(j)}$

S(j) and *B(j)* are the selling and buying prices of the transaction;
m is the number of transactions in the sample;
T is the number of trading days in the sample.

[7] The trading volume series of DAX dates back only to 2003 in *DataStream*.

3. Results and Conclusion

Table 2 reports the annualized rate of return (in percentage). Figures in parentheses are numbers of transactions. The last column shows the return rate of the buy-and hold strategy. For each index, the rule that generates the highest rate of return is bolded. For instance, the 50-day OBVMA rule produces the highest return for the Hang Seng Index over the past 20 years. The OBV outperforms the buy-and-hold strategy in six out of the nine indices. In particular, the 10- and 50-day OBVMA perform well in predicting price movements. The performance of the OBV is phenomenal in the stock markets of China. For example, the highest annual return for the Shanghai B market is 34.85%. The integration of the Greater China has also benefited the stock markets in the region. For Hong Kong, the highest annual return is 13.74%.

For Taiwan, the OBV generates a return of 10% per annum. In contrast, the OBV in general cannot beat the buy-and-hold strategy in the US and European markets. For the Dow Jones Industrials, CAC40 and FTSE100, the OBV generates returns significantly lower than the buy-and-hold strategy. The only exception is the 50-day OBVMA rule, which beats the buy-and-hold strategy in the Frankfurt DAX Index by a slight margin. Thus, the OBV trading rule is comparatively more effective in the markets of Greater China than in U.S. and European markets during our sample period.

Table 2: Annual Rate of Return of the OBV (%)

Index	10-day OBVMA	20-day OBVMA	50-day OBVMA	100-day OBVMA	Buy-and-Hold
Europe and US					
CAC40	-1.00(468)	-1.75(331)	0.96(117)	0.94(140)	**3.05**
DAX	-6.27(162)	-5.25(108)	**4.88(49)**	2.53(43)	4.29
Dow Jones	1.6(585)	2.35(390)	3.34(240)	2.86(180)	**6.40**
FTSE100	-0.53(556)	0.29(390)	1.24(246)	0.22(173)	**3.3**
Greater China					
TWSE	**10.08(494)**	8.52(334)	5.44(189)	9.26(92)	-1.36
Hang Seng	9.28(454)	10.76(301)	**13.74(171)**	9.15(115)	8.33
Shanghai A	**16.11(390)**	11.10(261)	7.58(147)	7.02(97)	7.11
Shanghai B	33.64(284)	**34.85(182)**	17.90(107)	15.19(76)	6.32
ShenzhenA	**24.66(380)**	19.46(249)	15.05(139)	9.00(84)	7.02

To incorporate the effect of transaction costs into our analysis, we compute the annualized transaction costs as follows:

$$c_A = \frac{250 c_w m}{T},$$

where c_w represents the cost of each transaction, and m and T are defined in Section 2. Tables 3a to 3c report the annualized transaction costs for c_w=0.1%, 0.25% and 0.5%.

Table 3a: Annualized Transaction Cost for c_w=0.5%

Index	10-day OBVMA	20-day OBVMA	50-day OBVMA	100-day OBVMA	Buy-and-Hold
Europe and US					
CAC40	13.41(%)	9.48	3.35	4.01	0.029
DAX	13.99	9.33	4.23	3.71	0.086
Dow Jones	14.55	9.70	5.97	4.48	0.025
FTSE100	13.75	9.64	6.08	4.23	0.025
Greater China					
TWSE	12.67	8.56	4.85	2.36	0.026
Hang Seng	11.48	7.61	4.32	2.91	0.025
Shanghai A	12.29	8.22	4.63	3.06	0.032
Shanghai B	10.23	6.56	3.85	2.74	0.036
ShenzhenA	11.83	7.75	4.33	2.62	0.031

Table 3b: Annualized Transaction Cost for c_w=0.25%

Index	10-day OBVMA	20-day OBVMA	50-day OBVMA	100-day OBVMA	Buy-and-Hold
Europe and US					
CAC40	6.70(%)	4.47	1.68	2.01	0.014
DAX	7.00	4.66	2.12	1.86	0.043
Dow Jones	7.27	4.85	2.98	2.24	0.012
FTSE100	6.87	4.82	3.04	2.14	0.012
Greater China					
TWSE	6.33	4.28	2.42	1.18	0.013
Hang Seng	5.74	3.80	2.16	1.45	0.013
Shanghai A	6.14	4.11	2.32	1.53	0.016
Shanghai B	5.12	3.28	1.93	1.37	0.018
ShenzhenA	5.92	3.88	2.16	1.31	0.016

Table 3c: Annualized Transaction Cost for c_w=0.1%

Index	10-day OBVMA	20-day OBVMA	50-day OBVMA	100-day OBVMA	Buy-and-Hold
Europe and US					
CAC40	2.68(%)	1.90	0.64	0.80	0.006
DAX	2.80	1.87	0.85	0.74	0.017
Dow Jones	2.91	1.94	1.19	0.90	0.005
FTSE100	2.75	1.93	1.22	0.86	0.005
Greater China					
TWSE	2.53	1.71	0.97	0.47	0.005
Hang Seng	2.30	1.52	0.86	0.58	0.005
Shanghai A	2.46	1.64	0.93	0.61	0.006
Shanghai B	2.05	1.31	0.77	0.55	0.007
ShenzhenA	2.37	1.55	0.87	0.52	0.006

To gauge more clearly the efficacy of the OBV rule, Table 4 reports the net relative rate of return of the OBV rule, which is obtained by deducting the annual transaction cost and the relevant buy-and-hold return from the absolute OBV return.

Table 4: Net Rate of Return (using 0.25% cost) of the OBV net of the buy-and hold return(%)

Index	10-day OBVMA	20-day OBVMA	50-day OBVMA	100-day OBVMA
Europe and US				
CAC40	-10.75	-9.54	-3.77	-4.12
DAX	-17.56	-14.2	-1.53	-3.62
Dow Jones	-12.07	-8.9	-6.04	-5.78
FTSE100	-10.17	-8.12	-5.1	-5.22
Greater China				
TWSE	5.11	5.6	4.38	**9.44**
Hang Seng	-4.79	-1.37	**3.25**	-0.63
Shanghai A	**2.86**	-0.12	-1.85	-1.62
Shanghai B	22.2	**25.25**	9.65	7.5
ShenzhenA	**11.72**	8.56	5.87	0.67

In general, the incorporation of transaction cost makes the rule unprofitable in all the European and US markets, but profitability is preserved in the Greater China area. The highest net return for each rule is bolded. It is found that the 10-, 20- day OBVMA rules are still the most profitable for the Shanghai A and the Shanghai B indices respectively. The 100-day OBVMA rule is now the most profitable in the Taiwan market. The netting of transaction cost favors the OBVMA100 as fewer trading signals are generated. Thus, our conclusion regarding the effectiveness of the OBV trading rule in Greater China still holds in the presence of trading costs.

To examine the trend of returns, Figures 1 to 3 plot the returns of the OBV over time. Returns for the US and European indices are plotted in Figure 1. Returns for the three mainland Chinese indices are plotted in Figure 2, while Figure 3 plots the cases for Taiwan and Hong Kong. The dotted lines in the figures indicate the trend of returns in the corresponding stock markets. Note from Figure 1 that the return of the OBV is generally lower and has gradually diminished in developed markets. If the effectiveness of a trading rule is a proxy for market efficiency, the result implies that these markets have become increasingly efficient over time.

Figure 2 shows that the OBV is increasingly profitable in the Chinese market. The trend line is fairly horizontal for Shanghai A and even slightly upward sloping for Shanghai B and Shenzhen A. This seemingly counter-intuitive observation can be accounted for by the fact that China has experienced a period of extremely rapid growth. The economic boom translates into a soaring stock market in 2005-2007, pushing the rate of return of the OBV to a level of 200%, which contributes to the rising trend of the OBV returns.[8] From Figure 3, we note that the trends of returns for the Hong Kong and Taiwan markets are only mildly downward sloping over the last two decades compared to the US and Europe. Thus, the boom of the Chinese economy has also fueled the return of the OBV trading rule for markets in the region.

[8] The clear spike of OBV return in 2006-2008 admittedly contributes to our conclusion that technical trading rules are increasingly profitable in China. However, since the Chinese stock market has a relatively short history, we believe it is not appropriate to further split the sample.

Figure 1: Returns of CAC, FTSE100 and Dow Jones

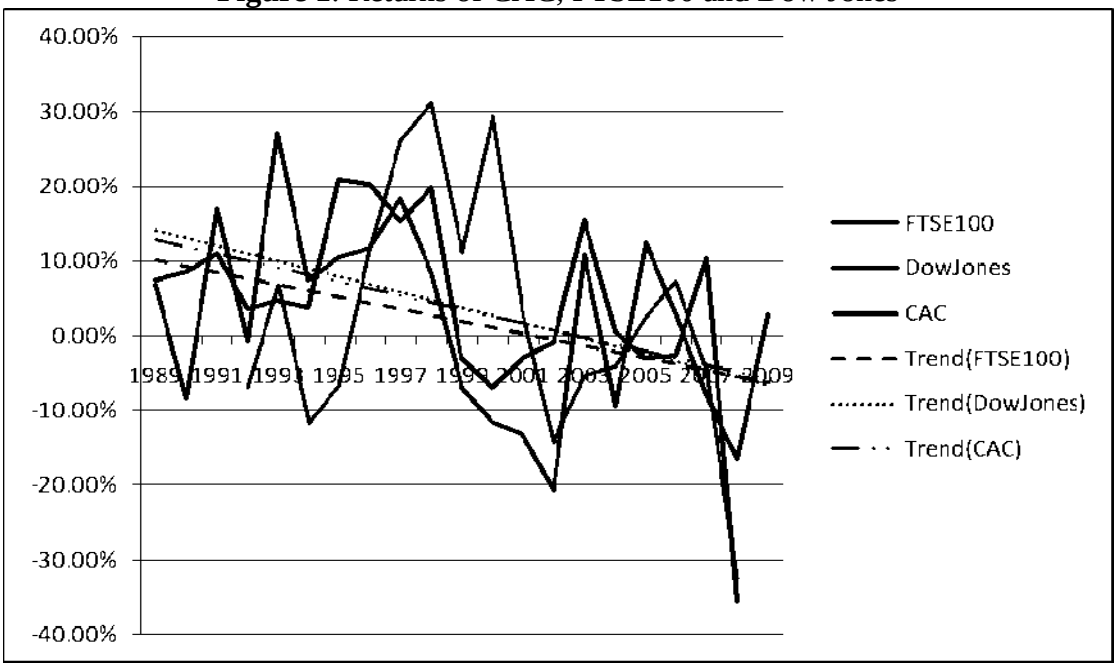


Figure 2: Returns of the Chinese Indices

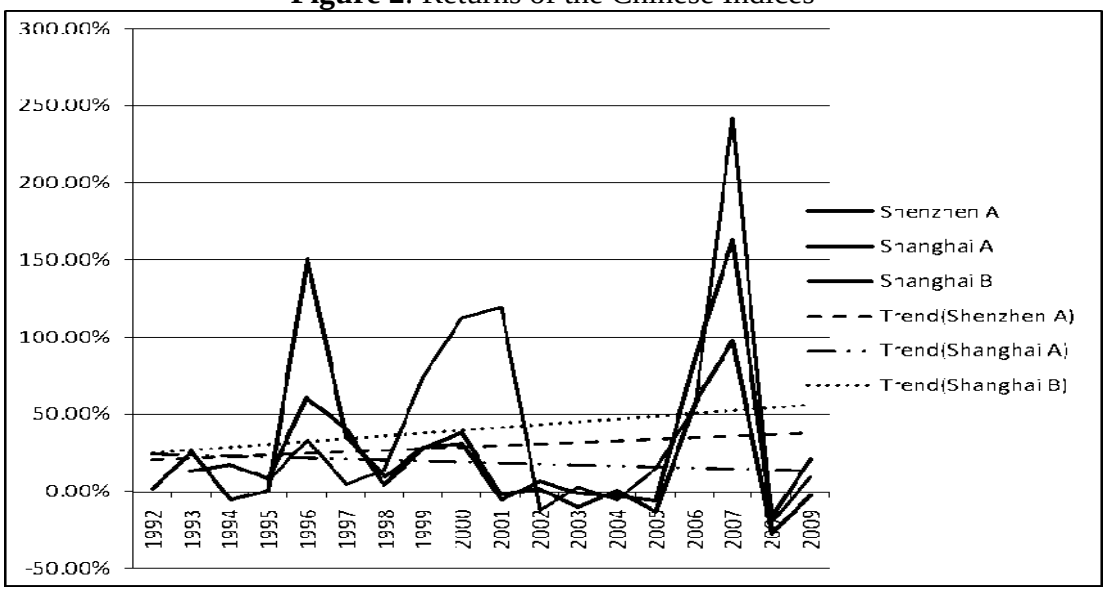
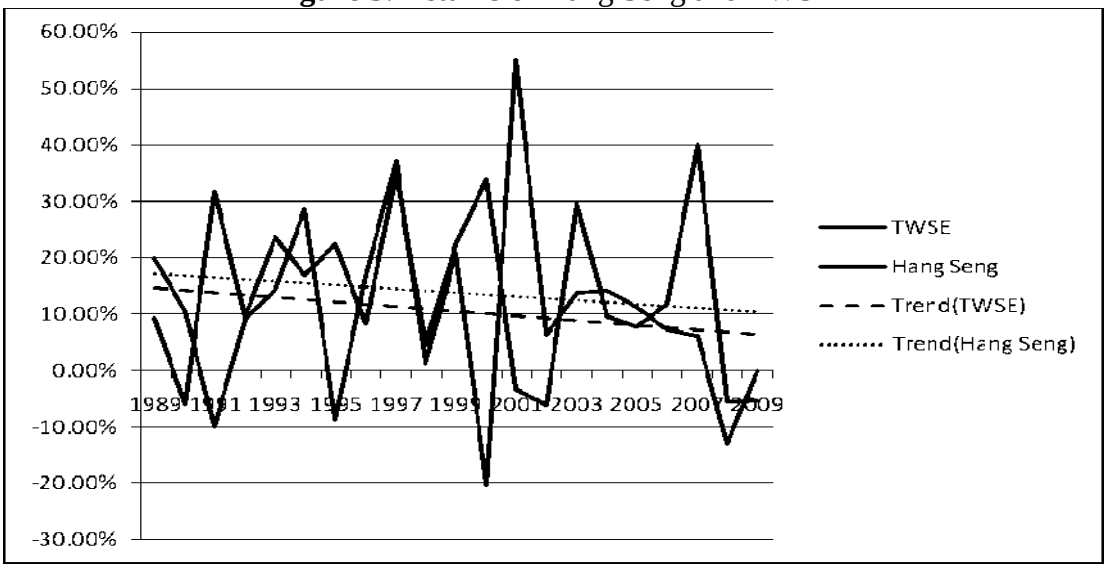


Figure 3: Returns of Hang Seng and TWSE



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