Statistics Analysis and Trending Strategies

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1. Introduction

Trending strategies are trading strategies that tend to capture gains through the analysis of asset's momentum. The trend trader enters into a long position when a stock is trending upward and enters a short position when the stock is in a down trend. Both momentum strategies and simple moving average strategies are typical trending strategies in investment decisions.

Momentum strategies are also called momentum investing. Momentum investing is a strategy of buying stocks that had higher returns over the past several months, and selling those stocks that had poor returns over the same period. An article written by Jegadeesh and Titman (2002) presents that Portfolio strategies that buy stocks with high returns over the previous 3–12 months and sell stocks with low returns over this same time period perform well over the following 12 months. Bange and Miller (2004) examine momentum investing in the context of the global asset allocation decision. Their study examines the relationship between historical asset class returns and changes in asset allocation recommendations given by 16 investment houses, from 1982 to 1999. Their results show mixed support for momentum investing as a determinant in the asset allocation decision. The moving average is a kind of technical analysis tool by creating updated average prices. A simple moving average is calculated by adding the closing price of the stock for a time period and then dividing this total by the time period. Investors regard the simple moving average as an indicator to make decision.

Based on the observations and articles, we decide to investigate the excess return of the two trending strategies by applying the Capital Asset Pricing Model (CAPM) theory and statistical analysis. We plan to explore the effects of utilizing these two strategies into securities investments in the United States stock markets.

2. Data

Our dataset consists of daily stock prices of S&P 500® listed companies from 2007 to 2017, which are taken from Yahoo Finance. For Momentum Strategy, we choose the data in the time range from Jan 1 2007 to Nov 1 2017 based on CAPM Single Factor Model. For Simple Moving Average Strategy, we choose the data in the time range from Nov 1 2012 to Nov 1 2017.

2.1 Momentum Strategy

In traditional momentum strategy, we select all the S&P 500® listed companies in utilities industry.

Table-1 93 S&P 500® listed companies in utilities industry

NEE	DUK	SO	EXC	NGG	AEP	SRE	PCG	ED	EIX
PPL	KEP	WEC	ES	DTE	OKE	BIP	AWK	ETR	AEE
HNP	CNP	BEP	LNT	PNW	ATO	NI	CPL	EBR	NRG
GXP	AES	OGE	SBS	WTR	SCG	VVC	CPN	IDA	PAM
APU	OGS	HE	ALE	NJR	SWX	SR	PNM	AVA	TGS
NEW	NYLD	SJI	TERP	CZZ	ABY	EE	MGEE	NEP	CWT
ELP	NWN	EDN	OTTR	TAC	DYN	SPH	CPK	SJW	CAFD

MSEX	YORW	D	SPKE	ARTNA	PCYO	CDZI	RGCO	CWCP	CTWS
PEG	CMS	WR	AWR	ORA	XEL	FE	UGI	WGL	BKH
PEGI	UTL	POR							

In momentum strategies, we choose monthly return to form momentum strategies and then do the data processing. The return of observing period is calculated by daily closing price at the end day in a certain month and the return of holding period is calculated by daily closing price at the beginning day in the same month.

Observing period:
$$R_{F,t} = \frac{P_t}{P_{t-1}} - 1 \tag{1}$$

Holding period:
$$R_{H,t} = \frac{P_{t+1}}{Pt} - 1 \tag{2}$$

2.2 Simple Moving Average Strategy

In simple moving average strategies, we investigate all the stocks of S&P 500® companies and randomly choose stocks to explain the efficiency of our simple moving average strategy. And we use the daily opening and closing price of stock to calculate the daily return. $r_{m,t}$ denotes the daily return of stock m in the trading day t.

$$r_{m,t} = \frac{P_{m,t}}{P_{m,t-1}} - 1 \tag{3}$$

3. Methodology and Strategy

3.1 Momentum Strategy

According to the momentum strategy, the selection of investment is to choose the stock with highest cumulative return in the observing period. At time t, the parameters of observing period holding period are J and K respectively. Applying the formula below, the cumulative return can be obtained as the indicator for selection.

$$CR_t = \prod_{i=1}^{J} (1 + R_{F,t-J+i}) - 1 \tag{4}$$

We assume two situations, without shorting and with shorting. At time t without shorting, we sort all the stocks in the utility industry by the cumulative return and only select the stock with the highest return for investment in the following holding period K. With shorting, we also short the stock with the lowest return in addition to buying the stock with highest return. At time t + 1, we apply the same method and repeat the method to time t + K. At time t + K, we sell the stock purchased at time t and buy a new stock according to the method mentioned above. In the following investment period, we hold the equally weighted portfolio of K stocks with adjustments. We set the range for both observing period and holding period as 1 to 12.

3.2 Simple Moving Average Strategy

According to the simple moving average strategy, we firstly calculate the moving average price during the lagging length L. We set the lagging length L in the range from 1 to 50, which represents 1 days to 50 days.

$$A_{t,L} = \frac{P_t + P_{t-1} + \cdots + P_{t-L}}{L} \tag{5}$$

We also assume two situations here, without shorting and with shorting. At trading day t, if the closing price of a certain stock at day t – 1 is higher than its moving average price calculated, we buy this stock. Otherwise, we don't consider this stock without shorting or we short this stock if admitted.

$$r_{m,t,L} \begin{cases} r_{m,t}, if\ P_{m,t-1} > A_{m,t-1,L} \\ 0, otherwise \end{cases} \tag{6}$$

4. Analysis

4.1 Momentum Strategy

CAPM Single Factor Model can be extended. If we were to extend the return being composed of some unexplained return characteristic and some relationship to a market premium, we can construct a factor model:

$$r_{i,t} = \alpha + \beta_i f_i + \epsilon_{i,t}$$

$r_{i,t}$: the return of asset i at time t
α_i : the abnormal return offered by asset i (unexplained expected return)
β_i : the beta of asset i to factor f_t
f_t : the factor's effect on the asset's return at time t
ε_t : the error term associated with the return of asset i at time t (unexpected return)

4.1.1 Statistical Analysis

To analyze the effectiveness of regression, we randomly select the K value and J value to observe the corresponding regression summary. The parameters of observing period holding period are J and K respectively.

Table-2
Given J=3, the result of regression with shorting or not in different K values

Given that J=3	The Situation without Short		
K value	Intercept	Slope	Adjusted R-squared
K=3	0.002867(-)	0.656890(**)	0.0661
K=4	0.002302(-)	0.623106(***)	0.0786
K=5	0.003802(-)	0.693019(***)	0.1204

K=6	0.004101(-)	0.676022(***)	0.1288
K=7	0.006379(-)	0.737171(***)	0.1557
K value	**The Situation with Short**		
K=3	0.009546(-)	-0.276122(-)	-0.0031
K=4	0.02090(-)	-8.70152(***)	0.4084
K=5	0.03425(-)	-13.63764(***)	0.4033
K=6	0.03703(-)	-16.98585(***)	0.4019
K=7	0.04388(-)	-19.27829(***)	0.3971

Significant level: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '-' 1

Table-3

Given K=8, the result of regression with shorting or not in different J value

Given that K=8	**The Situation without Short**		
J value	**Intercept**	**Slope**	**Adjusted R-squared**
J=1	-0.01709 (-)	9.29755 (***)	0.4620
J=2	-0.006655 (-)	4.954918 (***)	0.5002
J=3	0.006294 (-)	0.795514 (***)	0.1852
J=4	0.003862 (-)	0.806107 (***)	0.1881
J=5	0.0009405 (-)	0.8062515 (***)	0.1812
J value	**The Situation with Short**		
J=1	-0.001791(-)	-0.122382(-)	-0.0007
J=2	0.02725(-)	-12.59251(***)	0.3986
J=3	0.04527(-)	-20.98605(***)	0.3947
J=4	0.05119(-)	-25.25836(***)	0.3947
J=5	0.04361(-)	-25.23926(***)	0.3950

Significant level: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '-' 1

Firstly, we choose the data in the time range from Jan 1 2007 to Nov 1 2017 based on CAPM Single Factor Model and set the parameter J equals 3 and parameter K equals 5.

We can assess the model by R-squared, a corrected goodness-of-fit (model accuracy) measure of how close the data are to the fitted regression line. According to the Table-2 and Table-3, given the value of J fixed without shorting, as the value of K increases, the adjusted R-squared increases monotonously which means the return of market can be explained by the model better. But actually, the adjusted R-squared in any scene is less than 60 per cents. Thus, this model can't explain the return of market well.

According to the Table-2 and Table-3, comparing the result in the situation with shorting to that in the situation without shorting, we found out that the intercept of shorting situation is higher than that without shorting position when the value of the K and J are the same. Therefore, the strategy with shorting has higher abnormal return.

The regression is obtained as the figures display below. Both the intercepts are positive, 0.005842 and 0.002564 respectively, which confirms that the momentum strategies help investors earn excess return on market return generally. However, with the significance level equals to 0.05, no matter how we change the value of K or J, the hypothesis that the intercept which represents the abnormal return offered by the portfolio equals zero can't be rejected.

Figure-1 Regression of Strategy Return on Market Return without Shorting

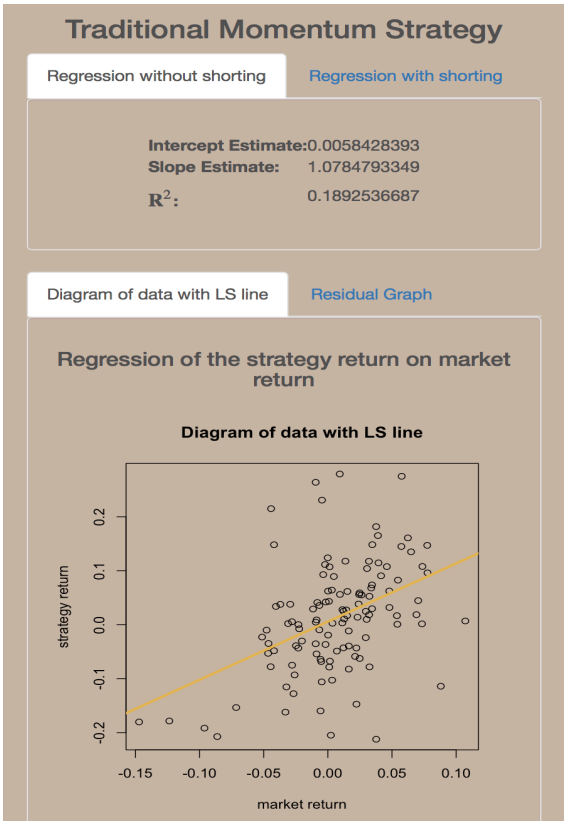
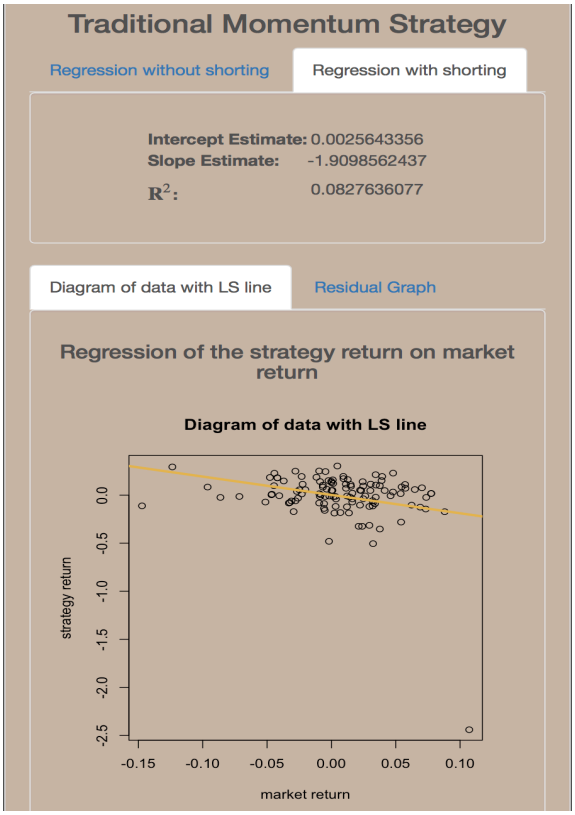


Figure-2 Regression of Strategy Return on Market Return without Shorting



4.2 Simple Moving Average Strategy

Table-4

Regression for different stocks through Simple Moving Average Strategy

Stocks	The Situation without Shorting		
	Intercept	Slope	Adjusted R-squared
AAPL	-8.842e-02 (***)	-1.746e-04 (***)	0.2833
GOOGL	3.522e-01 (***)	-3.185e-04 (***)	0.4522
AMZN	3.899e-02 (***)	-2.707e-05 (***)	0.0216
FOX	1.758e-01 (***)	2.258e-04 (***)	0.4083
COST	-7.632e-02 (***)	2.832e-04 (***)	0.6282
MSFT	-9.286e-02 (***)	5.920e-04 (***)	0.8346

HSBC	5.426e-02(***)	1.428e-04 (***)	0.5403
	The Situation with Shorting		
AAPL	2.327e-02 (**)	-2.424e-04 (***)	0.3226
GOOGL	5.191e-01 (***)	-3.078e-04 (***)	0.1988
AMZN	9.008e-03 (***)	-1.798e-04 (***)	0.4413
FOX	1.255e-01 (***)	1.276e-04 (***)	0.1440
COST	-1.590e-01 (***)	2.017e-04 (***)	0.3231
MSFT	5.803e-02 (***)	1.130e-04 (***)	0.0910
HSBC	2.750e-02 (***)	4.334e-05 (***)	0.0734

Significant level: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '-' 1

Figure-3 Regression of Strategy Return on Time of AAPL without Shorting

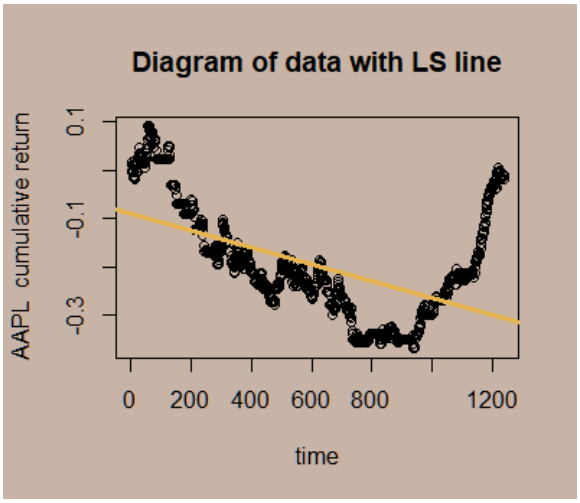
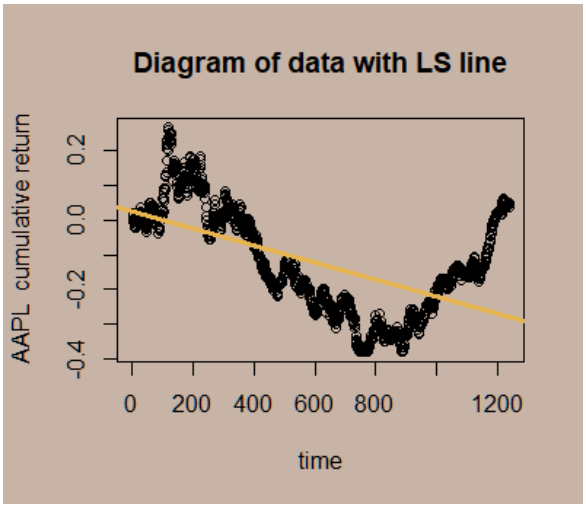


Figure-4 Regression of Strategy Return on Time of AAPL without Shorting



According to the figure above and the Table-4, whether shorting or not, the slopes of certain stock which represents the efficiency of Simple Moving Average Strategy are similar. We conclude that shorting position doesn't contribute to the strategy's return.

Table-5

Regression in different lagging length for AAPL

Lagging Length	The Situation without Shorting		
	Intercept	Slope	Adjusted R-squared
T=10	-1.123e-01 (***)	9.786e-05 (***)	0.10700
T=20	-2.601e-01 (***)	3.856e-05 (***)	0.01589
T=30	-1.116e-01 (***)	-3.329e-05 (***)	0.01381
T=40	-1.147e-01 (***)	-6.785e-05 (***)	0.06901
T=50	-1.229e-01 (***)	-6.506e-05 (***)	0.05771

Significant level: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '-' 1

According to the Table-5 above, changing the length of lagging can't significantly change the slope which can approximately measure the cumulative return of strategy over time.

5. Conclusion

Through our test, the portfolio constructed by the Momentum Strategy can't offer abnormal return compared to the market return. And comparing the result in the situation with shorting to that without shorting, we find that the intercept of shorting situation is higher than that of without shorting position when the value of the K and J are the same. It proves that Momentum Strategy with shorting has higher abnormal return.

The regression through Simple Moving Average Strategy can't generate the positive slope to exceed the normal market return over time whether shorting or not. Changing the length of lagging can't significantly change the slope either.

References

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