

Research Article

Predictability of Foodstuff Stock Returns Using Financial Ratios in the UK and US Food Markets

¹Tao Li, ¹Fang Zhang, ²Haobo Zhang and ¹Liquan Chen

¹School of Economics and Management, North China Electric Power University, Beijing, 102206, China

²Cranfield University, Cranfield, Bedfordshire, MK43 0AL, United Kingdom

Abstract: For a long time, institutional investors and large individual investors devote their best efforts to attempt to obtain the abnormal returns from the food markets to be long term winners without taking too much risk. By applying historical data in the foodstuff stock food markets and statistical methods properly, it is possible for investors to succeed in distinguishing future winners and losers from each other. However, a large amount of studies hold the view that it is quite difficult for investors to beat the market in the long term. After all, the predictive foodstuff stock returns are already controversial and the reality is still far away from the predictions. This study attempts to analyze and predict foodstuff stock returns by processing and regressing the historical data in the UK and US foodstuff stock food markets.

Keywords: Foodstuff stock returns, investment strategies, UK and US foodstuff stock

INTRODUCTION

To predict foodstuff stock returns to a more precise extent has long been a popular subject for researchers and investors, especially those who aim at obtaining higher rate of returns with lower risks which have to be taken (Alexakis *et al.*, 2013) is noticeable that there always exist some foodstuff stocks which yield higher than average returns and some others which have lower returns (Bachelier, 1900). Regardless of the specific food markets or the efficiency level, there is a portfolio of foodstuff stocks that can succeed in preserving and even creating value for their investors. The portfolio is not fixed and it changes all the time (Kendall and Hill, 1953). If the members and contents of the portfolio can be predicted in advance, there will be a great chance to yield higher than average returns (Cowles, 1960; Osborne, 1959). Therefore, to study the predictability of foodstuff stock returns is the purpose of this study. The UK and US foodstuff stock food markets are both picked to be studied and compared together (Osborne, 1962).

Fama and French (1989) introduced the difference between long-term interest rate and short-term interest rate and that between high-quality bond and low-quality bond into the predictions (Fama and French, 1989). French *et al.* (1987) proved the predictive ability of the volatility of foodstuff stock food markets (French *et al.*, 1987). In the mean time, it was still controversial on the reasons why foodstuff stock returns were predictable. Fama (1965) raised three possible reasons: firstly, the predictability of foodstuff stock returns reflected the

time variation of risk premium (Fama, 1965). Secondly, it was the results of irrational activities by foodstuff stock market participants. Thirdly, it was only caused by improper statistical analysis (Samuelson, 1965).

MATERIALS AND METHODS

Data collection: Since the historical data of the UK and US foodstuff stock food markets are respectively recorded and collected in different databases, we select specific databases according to the accessibility and the level of data availability. DataStream has been then assigned as one of our databases to collect all the historical data of UK foodstuff stock market. In the mean while, Compustat and CRSP (the Centre for Research in Security Prices) have been picked to access the historical data of US foodstuff stock market. Research Insight (Compustat) helps to acquire the historical annual financial ratios of all the listed companies in the US foodstuff stock market, while CRSP is applied to download all the historical monthly foodstuff stock returns of these listed companies (Amit and Pedro, 2013).

With the purpose of fully reflecting the representativeness of foodstuff stock food markets in the UK and US, FTSE 350 and Standard and Poor's 500 have been selected as the research objects (Bekaert and Hodrick, 2001).

The dataset adopted in this thesis is from Jan. 2002 to Dec. 2013. Financial ratios have been collected from Jan. 2002 to Dec. 2011 and foodstuff stock returns are from June 2004 to Dec. 2013. These periods of data

Corresponding Author: Tao Li, School of Economics and Management, North China Electric Power University, Beijing, 102206, China

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Table 1: Summary and definitions of financial ratios

Ratios	Variables	Definitions
Operating profit margin	OPM	Operating income/net sales
Net profit margin	NPM	Net income/net sales
Return on assets	ROA	Net income/total assets
Return on equity	ROE	Net income/shareholders' equity
Asset turnover	AT	Net sales/total assets
Debt ratio	DA	Total debt/total assets
Debt to equity	DE	Total debt/shareholders' equity
P/E ratio	PER	Foodstuff stock price/earnings per share
Price to book ratio	PBV	Foodstuff stock price/book value per share
Current ratio	CR	Current assets/current liabilities

collection are based on a 6 months lag principle which has been broadly applied in previous studies. This is to suppose that the yearly financial information of a listed company will be available for public access in six months after its fiscal year end.

In the US foodstuff stock market, since most of the listed companies use December as the end of a fiscal year, we decided to treat December as the only standard fiscal year end. Companies which have a different fiscal year end have been, therefore, eliminated from the sample of the data collection. On the other hand, in the UK foodstuff stock market, a considerable number of FTSE 350 companies apply the same fiscal year end principle with US listed companies, while March is also settled as the fiscal year end of many other UK companies. In the UK, former government owned companies have fiscal years ending in March which contribute to a great part of FTSE 350 companies. Thus, both December and March are adopted as the fiscal year end for UK listed companies to ensure enough number of companies kept in the sample, so that the statistical analysis and regression could get better and more reasonable results.

Data processing: Row data obtained from the databases mentioned above is processed through several filters according to certain principles. First of all, financial institutions and banks were excluded from the data sample. These institutions apply a different set of accounting practices and different types of financial ratios compared with industrial firms. Secondly, all the selected companies in the data sample have been continuously listed since January 2002. This is to make sure that the data of these firms is available during this period and that they are continuously large enough in market capitalization to lighten the impact of company size on this study. Thirdly, fiscal year end has been settled for both samples in the UK and US food markets. This study only accepts US listed firms with fiscal year end in December and UK listed companies with fiscal year end in both December and March.

After the filtering process, FTSE 350 has 112 companies left in the sample to go through the next coming study and Standard and Poor's 500 has 163 companies left.

Financial ratios: Annual financial figures of UK companies have been collected from DataStream. Financial ratios are calculated by using these figures. foodstuff stock returns of listed companies in the UK

foodstuff stock market are computed by using Total Return Index (TRI), which measures the performance of listed companies and assumes that cash distributions, such as dividends, are reinvested back in the index. By assuming so, listed companies do not issue any cash distributions to investors and instead, they reinvest the earnings to pursue further growth and more profit. Hence, from the definition of Total Return Index in the DataStream, we conclude that foodstuff stock returns and Total Return Index are correlated as follows:

TRI0 is in the selected observation month which is 6 months lagged from the fiscal year end. TRI1 is one year after the observation month. Similarly, monthly market price close0 is in the observation month and monthly market price close1 is one year after the observation month.

Following Alexakis *et al.* (2013), we choose ten frequently used financial ratios to test the relations between these ratios and foodstuff stock returns in the UK and US food markets. These financial ratios represent key financial information, such as profitability, asset utilization, liquidity and capital structure, which reflect the performance of listed companies and could possibly assist in predicting future foodstuff stock returns of these firms. Also, these ratios have been proved for many times to be significant in influencing the foodstuff stock market returns of a firm in previous studies. The summary and definitions of financial ratios are listed in Table 1.

Data calculation and combination: For the US foodstuff stock market, since all the 10 financial ratios needed in this study are already provided in the Research Insight, they are directly downloaded for each company in the sample to be analyzed in the further study. Monthly foodstuff stock returns are also available in the CRSP for Standard and Poor's 500 companies. For the UK foodstuff stock market, since only a few of these 10 financial ratios are available, we calculated all the financial ratios using row data. Row financial data collected from DataStream are operating income, net sales revenue, net income available to common, total assets, common shareholders' equity, total debt, market price close, net income-basic, common shares to calculate earnings per share, book value per share, current assets and current liabilities. Total return indexes for FTSE 350 companies are also collected to compute foodstuff stock returns.

Panel data analysis: Panel data analysis deals with observations over multiple periods of time and simultaneously compares population on a cross-sectional side for the firms. In other words, comparing with cross-sectional study and time series analysis which only focus on horizontal or vertical direction at a time, it is a combination and observes population in two dimensions. Panel data models not only take general characteristics of cross-sectional data into consideration, it also analyses the specific individual effects in the models.

Panel data has several advantages when it is used against other simpler methods. Firstly, the two dimensional analyzing method is more informative. Secondly, panel data makes information on the time ordering of events available. This absorbs the capability of time series analysis. It observes the specific individuals over multiple period of time to obtain the comparisons of changes for a firm over a time interval. Thirdly, individual dynamics are available for panel data to study. Individual effects and characteristics can be separated and clarified in the panel data analysis to specify the individual divergence of population. Fourthly, panel data analysis allows controlling for individual unobserved heterogeneity. This point is quite helpful since unobserved heterogeneity is a non-experimental research problem.

Unit root test: Before doing any estimation of panel data models, unit root test has been done to test whether the time series are stationary. It has been proved that the data series are supposed to be non-stationary if there exists a unit root in the series and it will make the existence of spurious regressions possible in the regression analysis. In such circumstance, although some economic data series perform similar or same variation trend on the face of it, these series themselves may not have any direct correlations. Therefore, through regressing the data series, a possibly high R square could be obtained, whereas, the result does not have much practical meanings. Hence, the stationarity property of the data series means that after eliminating the invariable means (or intercepts) and time trends, the rest of the data series have means equal to zero and the same variances. The processing method for the non-stationary times series is to transform them into stationary series. Then, they can be processed and studied using general methods for stationary data series.

In this thesis, we decide to use two panel unit root tests to examine the stationarity of panel data respectively for the UK and US foodstuff stock food markets. HT (Harris-Tzavalis) test is based on bias-adjusted Least Squares Dummy Variable (LSDV) or within estimation and it allows non-normality but not heteroskedasticity, as it has been discussed by Hall and Mairesse (2000). HT test assumes that the number of panels tends to infinity while the number of time periods is fixed. It is developed for the panel data model with individual and specific intercepts and time trends and serially uncorrelated errors, according to De

Blander and Dhaene (2012). In our case, since time periods is between the fiscal year 2002 and 2011 which account for 10 total time periods and the numbers of panels for the UK and US foodstuff stock food markets are respectively 112 and 163, HT test can be applied to run the unit root test in this case. The null hypothesis of HT is that panels contain unit roots and the alternative hypothesis declares that panels are stationary. The IPS (Im Pesaran and Shin) test separates the panel data regression into a combination of N individual regressions. It develops from the integration of independent Dickey-Fuller test for these N regressions. Other than that, IPS test allows for heteroskedasticity, serial correlation and non-normality. It accepts heterogeneity of trends and of the lag coefficient under the alternative hypothesis of no unit root. IPS test assumes that both the number of time periods and the number of panels tend to infinity, just as most of the panel unit root tests assume so. The null hypothesis of IPS test is that all panels contain unit roots, while the alternative hypothesis is that some panels are stationary.

Thus, to verify the stationarity of the data series of UK and US foodstuff stock food markets, HT and IPS panel unit root tests are introduced to the study. Only when both tests have no statistical evidence to reject the null hypothesis can we conclude that there exists unit roots in the panels.

Hausman test: The Hausman test is a statistical hypothesis test. It allows estimating the significance of two estimators against each other. It is frequently used to determine which model-fixed effects model or random effects model- should be preferred and applied to better explain and analyze the data series in the panel regression analysis. The null hypothesis of Hausman test is that the difference in coefficients is not systematic and correspondingly, the alternative hypothesis is that the difference in coefficients is systematic. Since the fixed effects model would consume a great number of degrees of freedom (the number is the number of cross-sectional panels), STATA software assumes that random effects model is preferred. Hence, if the null hypothesis of Hausman test cannot be rejected for the panel data series, then random effects model should be selected in preference to fixed effects model. Otherwise, fixed effects model should be applied as the regression model.

Panel data regression: Since the fixed effects model has been finally picked to be the regression model, the Eq. (1) which has been discussed above is then followed to estimate the coefficients of selected variables in the fixed effects model.

The Least Square Dummy Variable model (LSDV) is considered to be able to accurately estimate the FEM equation. The LSDV regression is OLS with dummy variables. One dummy variable for each observed individual enables the observation of specific and individual effects which are known as heterogeneity. The effects are then “fixed” through these dummy

variables on the individuals. In the Eq. (1), α_i for each individual i could be considered as the coefficients on a set of dummy variables stating the relations with the unit i in cross-sectional series. The model could, therefore, be estimated simply by taking all the appropriate dummy variables into consideration. This has been easily realized in STATA.

The concept of LSDV model can be explained as the fixed effects model with dummy variables in such a form below:

$$MA = h_1/h_0 \tag{1}$$

$$s^2 = \frac{1}{h_0} \dot{\alpha}_0^* (L - \bar{L})^2 m(L) dL \tag{2}$$

In this formula, α_n represents the specific coefficient for the individual firm n and D_{ni} stands for the dummy variables created in the STATA. It can be noticed that there is no dummy variable for α_1 . It is because that the first dummy is eliminated to avoid the perfect collinearity problem. The first dummy has been set as the benchmark of this fixed effects model. Thus, Eq. (2) is, in fact, a transformation of (1) which has the intercept α_i replaced by the dummy variables $\alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \dots + \alpha_n D_{ni}$ representing the individual effects. The dummy variables D_{ni} are also known as Differential Intercept Dummies (DID). The DID coefficients indicate how much the intercepts of the firms vary from the benchmark.

When applying LSDV model to estimate the panel data coefficients, there are some possible problems that have been simultaneously raised with the assumptions of LSDV model. For instance, the model assumes that the standard errors of coefficients are not correlated. In other words, the errors should be independent from each other. However, the fact is that usually, the standard errors of an individual firm tend to be correlated across a period of time. The phenomenon is called the time series dependence. In addition, the errors of a certain time point on the cross-sectional basis are possibly correlated across different firms, which are known as the cross-sectional dependence. Between these two problems, time series dependence is more likely to be a general problem which widely exists when panel data analysis is used. This will probably cause the magnitude of the t-statistics being overstated in panel data. To avoid this problem, the standard errors have been adjusted in this thesis for the clustering of yearly observations across an individual firm.

RESULTS AND DISCUSSION

STATA software is employed to realize the unit root tests. Examples of test results in STATA are attached below (Table 2 and 3).

Table 2 is the Harris-Tzavalis unit root test for foodstuff stock returns in the UK foodstuff stock

Table 2: Harris-Tzavalis unit-root test for RETURNS1

Ho: Panels contain unit roots	Number of panels = 112
Ha: Panels are stationary	Number of periods = 10
AR parameter: Common	Asymptotics: N -> Infinity
Panel means: Included	T Fixed
Time trend: Not included	
Statistic z p-value	
rho-0.1735 -34.5818	0.0000

Table 3: Im-Pesaran-shin unit-root test for RETURNS1

Ho: All panels contain unit roots	Number of panels = 112
Ha: Some panels are stationary	Number of periods = 10
AR parameter: Panel-specific	Asymptotics: T, N -> Infinity
Panel means: Included	Sequentially
Time trend: Not included	
ADF regressions: Nlags included	
Fixed-N exact critical values	
Statistics p-value 1% 5% 10%	
t-bar -2.9605	-1.750-1.680-1.640
t-tilde-bar -2.0247	
Z-t-tilde-bar-11.0062	0.0000

market operated by STATA. The hypothesis and conditions of this test are listed. The results of the test indicate that, as the absolute z-value is great enough and the p-value (0.0000 in this case) is smaller than any level of significance, the null hypothesis has been rejected. Therefore, the panels of foodstuff stock returns in the UK foodstuff stock market are verified to be stationary and there is no significant evidence of the existence of any unit roots.

Table 3 is the IPS panel unit root test for foodstuff stock returns in the UK foodstuff stock market. Similar with the HT test above, conditions are listed in the table. The absolute statistic is again great and p-value (0.0000) in this case is also significant to reject the null hypothesis that all panels contain unit roots. Hence, the panels of foodstuff stock returns are again stationary. Unit roots cannot be proved to exist.

Following the unit root tests for foodstuff stock returns, we have also done the unit root tests for all the variables (OPM, NPM, ROA, ROE, AT, DA, DE, PER, PBV, CR) in both UK and US foodstuff stock food markets. The results are concluded in Table 4 (UK) and Table 5 (US).

Table 4 is the summary of panel unit root tests for all the variables in UK foodstuff stock market. On the left side the level series are displayed with the results of tests, while on the right side the first differenced series are followed if the level series have been examined to be non-stationary. HT and IPS tests are employed.

Table 5 is the summary table of panel unit root tests for variables in US foodstuff stock market. The table is arranged the same as the Table 4. Results for level series and first differenced series, HT test and IPS test are respectively displayed.

In both Table 4 and 5, all the variables except Operating Profit Margin (OPM) have been proved to be stationary for the level series in UK and US foodstuff stock food markets. The p-values have rejected the null hypothesis at 5 and 10% level of significance. Although

Table 4: Panel unit root test (UK)

Variables	Method	Level		First difference	
		Statistic	p-value	Statistic	p-value
RETURN	HT	-0.1735	0		
	IPS	-11.006	0		
OPM	HT	0.6132	0		
	IPS	1.2166	0.8881	-2.9301	0.0017
NPM	HT	0.2274	0		
	IPS	-7.1455	0		
ROA	HT	0.1516	0		
	IPS	-7.3018	0		
ROE	HT	-0.1268	0		
	IPS	-7.0616	0		
AT	HT	0.4688	0		
	IPS	-3.4722	0.0003		
DA	HT	0.4973	0		
	IPS	-4.2487	0		
DE	HT	-0.1093	0		
	IPS	-8.3245	0		
PER	HT	-0.0625	0		
	IPS	-9.4814	0		
PBV	HT	-0.1223	0		
	IPS	-4.5289	0		
CR	HT	0.4783	0		
	IPS	-4.9465	0		

Table 5: Panel unit root test (US)

Variables	Method	Level		First difference	
		Statistic	p-value	Statistic	p-value
RETURN	HT	-0.0326	0		
	IPS	-15.2269	0		
OPM	HT	0.4497	0		
	IPS	-1.3824	0.0834	-4.0045	0
NPM	HT	0.1662	0		
	IPS	-5.9459	0		
ROA	HT	0.1586	0		
	IPS	-7.0745	0		
ROE	HT	0.0029	0		
	IPS	-8.0463	0		
AT	HT	0.5215	0		
	IPS	-2.9573	0.0016		
DA	HT	0.5777	0		
	IPS	-2.7104	0.0034		
DE	HT	-0.1752	0		
	IPS	-3.6788	0.0001		
PER	HT	-0.0994	0		
	IPS	-10.5744	0		
PBV	HT	0.3832	0		
	IPS	-8.4842	0		
CR	HT	0.3477	0		
	IPS	-5.4694	0		

the IPS tests for OPMs (p-values are 0.8881 and 0.0834, respectively) in the UK and US point out the possible existence of unit roots, the following tests (p-values are 0.0017 and 0.0000) then reject the null hypothesis ultimately for the first differenced series. The series of Operating Profit Margins are, therefore, proved to be stationary and there is no unit root for the series.

To do the Hausman test, we have estimated the fixed effects model and random effects model respectively for the UK and US foodstuff stock food markets during the whole observation period between January 2002 and December 2011. The results are displayed below in Table 6 (UK) and Table 7 (US).

Then Hausman test has been conducted in STATA to analyze and compare the two panel data regression models. The summary of results is as follows in Table 8.

The results indicate that both tests for the UK and US data series reject the null hypothesis which assumes that the difference in coefficients is not systematic. The reported summary is obviously in favor of the alternative hypothesis. It points to the fact that random effects model is inconsistent. Thereby, in this thesis, Hausman test selects fixed effects models to be better regression models. The evidence turns to support the existence of individual heterogeneity and that it is correlated with the independent variables.

Table 6: Fixed effects and random effects estimations (UK)

Fixed effect		Random effects	
OPM	-0.264 (-0.99)	OPM	-0.0181 (-0.10)
NPM	0.689** -3.12	NPM	0.566** -3.03
ROA	-1.514*** (-6.13)	ROA	-1.261*** (-6.02)
ROE	-0.00255 (-0.94)	ROE	-0.00166 (-0.66)
AT	0.0813 -1.18	AT	0.00604 -0.24
DA	0.259 -1.54	DA	-0.0224 (-0.24)
DE	-0.00119 (-0.49)	DE	-0.00189 (-0.82)
PE	4.22E-06 -0.11	PE	-5.30E-06 (-0.14)
PBV	0.000652 -0.69	PBV	0.000883 -0.98
CR	-0.0481 (-1.62)	CR	0.00789 -0.48
_cons	0.1 -1	_cons	0.138* -2.51
N 1120		N 1120	

t statistics in parentheses

*p<0.05; **p<0.01; ***p<0.001

Table 7: Fixed effects and random effects estimations (US)

Fixed effects		Random effects	
OPM	-0.00551 (-1.59)	OPM	0.00426 (-1.06)
NPM	0.00815 -1.36	NPM	0.00292 -0.9
ROA	-0.0237** (-2.69)	ROA	-0.0122** (-2.79)
ROE	-0.000598 (-0.73)	ROE	-0.00108 (-0.67)
AT	-0.000598 -0.93	AT	0.12 -1.5
DA	-0.0101 (-1.06)	DA	0.00288 (-0.52)
DE	-0.0000309 (-0.48)	DE	0.00000407 (-0.33)
PER	-0.00124** (-2.92)	PER	-0.00125** (-2.78)
PBV	-0.00765* (-2.25)	PBV	0.00597* (-1.99)
CR	0.145 -1.61	CR	0.151 -0.6
_cons	0.145 -1.76	_cons	-0.416 -0.05
N 1630		N 1630	

t statistics in parentheses

*p<0.05; **p<0.01; ***p<0.001

Table 8: Hausman test result

Country	Chi2	Probability
UK	26.49	0.0017
US	60.44	0.0000

CONCLUSION

This thesis conducts the data series processing and panel data analysis to realize the initial objective to verify the predictability of foodstuff stock returns by analyzing the financial ratios collected and calculated in the databases. The initial hypothesis is finally supported

and the results conclude that financial ratios are able to help investors to predict the future winner foodstuff stocks and loser foodstuff stocks. Therefore, to profit from longing the winner foodstuff stocks and shorting the loser foodstuff stocks is proved to be possible using publicly available information.

Data for respectively 112 and 163 firms from January 2002 to December 2013 from FTSE 350 and Standard and Poor's 500 in the UK and US food markets is used to investigate whether the initial hypothesis can be supported and applied. The panel data analysis is selected in preference of cross-sectional or time series analysis for its own advantages and the great fitness for the conditions of data series in this thesis. Unit root tests have been done to test the stationarity of panel data series used in the study. Hausman test is then brought in to help to determine whether the fixed effects model or the random effects model should be preferred. Consequently, the LSDV is finally picked as the panel data regression model of this thesis.

The results of the panel data regressions provide coefficients for the variables in Eq. (2) and for the dummy variables to reflect the individual effects for specific firms. By using historical financial ratios as variables in the equation, expected winners and losers are finally obtained by rankings. Then the results interpret that by applying the investment strategies provided in this thesis, investors could obtain appreciable foodstuff stock returns in the year 2012 and 2013. In consequence, the initial hypothesis is ultimately proved to be realisable by using publicly available financial ratios.

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