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LONG-TERM EVENT STUDY ON EARNINGS SURPRISES AND PRACTICAL PORTFOLIO CONSTRUCTION

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ABSTRACT

This study investigates the effect of quarterly earnings announcements for a large sample of US-listed companies in recent years (2008-2016). The research design involves regressions of total returns and residual returns on surprises, size, growth, accounting accruals, volume and announcement timing. Meanwhile, this study incorporates the effect of size and growth on the impact of earnings surprises into consideration. My results show the earnings and accounting accruals can be exploited to build an implementable portfolio, which has the annual return of 50.03% after hedging the beta, size, and growth.

1. INTRODUCTION

This study provides new evidence on the relation between earnings announcements and abnormal returns. This study follows the study done by Doyle *et al.* (2006) who document a stock price drift following the earnings announcement that can be exploited in portfolio construction, by defining the earnings surprises as the difference between actual EPS and analyst forecast EPS in I/B/E/S database. They discuss the impact of earnings announcements on total returns by regressing the post-earnings announcement effects on earnings surprises, accounting accruals, market microstructure variables and other risk control variables. They also find a way to construct portfolios to implement the earnings surprises. Combining with previous work by Doyle *et al.* (2006) this study incorporates the following post earnings announcements factors:

First, the regression considers the effect of announcement timing, including whether the announcement is published in a transaction day and whether it is published at a transaction time. Second, this study investigates the interaction between surprises and company characteristics, such as size and growth. Third, this study studies not only the total returns, but also the residual returns from Fama-French 3-factor model. Finally, in portfolio construction part, rather than directly exploiting the surprises and accruals in the existing literature, this study proposes a portfolio construction strategy hedged against beta, size and growth effects. After hedging, the strategy

to buy stocks with high earnings surprises and low accounting accruals and short sell stocks with reverse attributes, consistently produces high returns.

In the first part of the paper, the Fama-Macbeth regression (Fama and Macbeth, 1973) is implemented to explain the determinants of post-earnings drift. Most results coincide with the existing literature (Chambers and Penman, 1984; Damodaran, 1989; Chan *et al*., 2005; Doyle *et al*., 2006; Dellavigna and Pollet, 2009) including the slopes of surprises, accruals, timing, and interaction between surprises and size. However, some results do not coincide with the existing literature. For example, this study finds a different interaction between surprises and growth from the result of Skinner and Sloan (2002). The possible explanations can be different measures of returns and the impact of GFC. Then this study defines Fama-French three-factor model residuals as residual returns, which are a measure of hedged abnormal returns against beta, size effects, and value effects, and use residual returns to check the robustness of the model.

The second part of the paper focuses on the portfolio construction. This study puts different stocks into different portfolios by their surprises deciles and accounting accrual deciles. The risk factors across different surprises portfolios, such as beta, size, and growth, vary too much, so hedging for risk is necessary. This study uses residual returns from Fama-French model as hedged returns again beta, size, and growth. Using a strategy by buying high surprises low accruals portfolios and short selling low surprises high accruals portfolios, the aggregate hedged portfolio can generate a surprising return of 50.03% per annum.

2. LITERATURE REVIEW

The event study methodologies are well developed. Events studied by researchers range from internal announcements, such as announcements of financial reports and release of new products, to external announcements, such as regulatory changes and the entry of a large competitor. Sorescu *et al*. (2017) the cumulative abnormal return (CAR), buy-and-hold abnormal return (BHAR) and Jensen's alpha are the commonly used abnormal measures in event study (Kothari and Warner, 2007).

CAR method is the most popular in short-term event study (Brown and Warner, 1980; Brown and Warner, 1985; Mackinlay, 1997). In long-term abnormal return measures, BHAR (Buy and Hold Abnormal Return) and Jensen's alpha are widely researched. BHAR is the average multi-year return from a strategy of investing in all firms that complete the event and selling at the end of a pre-specified holding period versus a comparable strategy using otherwise similar non-event firms. In Jensen's alpha method, a portfolio is constructed comprising all firms experiencing the event within a time window, and Jensen's alpha is calculated to measure the impact of the event.

In recent papers about long-term abnormal returns, Fama-Macbeth regression of long-term returns (1-3 years) on earnings surprises and other control variables is conducted to see the quantitative relationship between long-term returns and earnings surprises (Doyle *et al*., 2006). They find that the returns subsequent to earnings announcements that are much larger, persistent for much longer, and more heavily concentrated in the long portion of the hedge portfolio than shown in previous studies. They show that after controlling for risk and accounting anomalies, the results are positive for every quarter between 1988 and 2000.

In addition, researchers find the growth firms have more reaction to earnings surprises than value firms, and the growth firms have more reactions on good news than on bad news. Skinner and Sloan (2002) these return differential arises because investors initially have overly optimistic expectations about the future earnings' prospects of growth stocks, leading to subsequent price declines when these expectations are not met (Lakonishok *et al*., 1994).

Many scholars have discussed the factors that influence the impact of earnings announcements on the stock prices. Some market microstructure variables (such as Bid-Ask Spread, Depth, Trade Size, Number of Trades, Stock Price, Percent Held by Institutions, Number of Funds, Percentage Change in the Number of Institutions, or Number of Analysts) around the announcement date show the impact on long-term return (Doyle *et al*., 2006). The

timeliness of earnings announcement has an influence on returns (Givoly and Palmon, 1982; Chambers and Penman, 1984; Damodaran, 1989). Dellavigna and Pollet (2009) argue that the stock prices respond less to Friday earnings surprises than to non-Friday earnings surprises immediately, in the event window (0,1). However, in a subsequent period, post-event window (2,75), stock prices respond more to Friday earnings surprises.

The account accruals also play a great role in the research on earnings. Hodgson and Van Praag (2014) argue that corporate insider trading based on accruals provides incremental information about future economic returns in Australia. Momente *et al.* (2015) suggest a stronger negative relation between accruals and future firm performance, and they explain accounting accruals as a systematic risk factor.

The researchers find that non-linearity in the relation between returns and earnings. Hayn (1995); Freeman and Tse (1992) argue that the coefficient on the earnings surprises from the regression of abnormal returns is non-linear and asymmetric. They argue that the permanent component of earnings surprises (as a percentage of total earnings surprises) increases as unexpected earnings approach zero because analysts and investors forecast high-value permanent earnings more accurately than low-value transitory earnings. This possibility allows us to predict that the marginal price response to earnings surprises should approach a composite price-earnings ratio as the earnings surprise approaches zero. They use arc tan function to model this phenomenon that slope increases as unexpected earnings surprise diminishes down to zero. Ederington *et al.* (2015) find heteroscedasticity in event study of bonds, and develop a new approach to deal with heteroscedasticity by standardization of bond yields.

3. METHODOLOGY

This study explores the post-earnings announcement drift where the surprises are measured by the difference between I/B/E/S analyst consensus analyst forecasts and the actual earnings. Total returns for one, two and three years after the earnings announcements are regressed to earnings surprises. Then this study controls the risks (beta, size, growth, and momentum), accounting accruals and announcement timing to check whether the result holds the same. The interaction between earnings surprises and asset size\market-to-book ratio is also added to the regression. This study adopts abnormal returns from Fama-French 3-factor model instead of total return into the regression to check the robustness of the result. Finally, this study explains the reason for special U shape of the relationship between the returns and surprises.

The dependent variable of the regression is earnings surprises defined as the I/B/E/S actual EPS minus most recent I/B/E/S median EPS forecast, scaled by the closing stock price in the quarter. Because the I/B/E/S quarter summary database is quite messy, this study cleans the I/B/E/S data by removing the data records in which the forecast period is after the announcement date or the CUSIP code is invalid.

The regression of total returns on earnings surprises and other risk factors are in Fama-Macbeth style, in which all the covariates are in terms of deciles. In other words, all independent variable in the regression, are taken into deciles and scaled into a number between zero and one. The advantage of Fama-Macbeth regression is that it smooths the data and coefficient estimate directly show the hedging profit from longing the top decile surprises portfolio and shorting the bottom decile surprises portfolio. However, sorting firms by deciles may suffer from a look-ahead bias because, at the earnings announcement date, we do not know the other firms' EPS. To avoid this bias, this study uses the cutoff values from period t-1 to define the earnings surprises deciles, and the results are same as the standard procedure.

$$R_{it} = \alpha_0 + \alpha_1 Surprise_{it} + \alpha_2 Beta_{it} + \alpha_3 Size_{it} + \alpha_4 BtoM_{it} + \epsilon_{it} \quad (1)$$

R_{it} is the total return of firm one year, two years or three years after the announcement. The surprise is measured by actual I/B/E/S EPS minus most recent I/B/E/S median forecast, scaled by stock price. Beta, Size, and BtoM are CAPM Beta, asset size, and book-to-market ratio respectively.

Furthermore, other factors, including accounting accruals, announcement timing, change in volume and momentum, are controlled to see the quantitative relationship between long-term returns and earnings surprises. In addition, the interactions between earnings surprises and asset size\book-to-market ratio are investigated.

$$R_{it} = \alpha_0 + \alpha_1 Surprise_{it} + \alpha_2 Beta_{it} + \alpha_3 Size_{it} + \alpha_4 BtoM_{it} + \gamma_1 Surprise_{it} \times Size_{it} + \gamma_2 Surprise_{it} \times BtoM_{it} + \alpha_5 Transactionday_{it} + \alpha_6 Transactionhour_{it} + \alpha_7 Momentum_{it} + \alpha_8 \Delta volume_{it} + \alpha_9 Accrual_{it} + \epsilon_{it} \quad (2)$$

In this equation, Transaction-day is a dummy to show whether the announcement is on the transaction day, and Transaction-hour is a dummy to show whether the announcement is in trading hours, which are from 9:00 to 16:30. Momentum is measured by market-adjusted return one quarter prior to the announcement. Δvolume is the percentage volume change of three days around the announcement against three days prior. Accruals are measured in a change of current asset less the cash divided by current liability less the interest-bearing debt inside. Accruals are very good estimates of net income quality. All the variables above are in terms of deciles as in the first regression.

This study also runs a robustness check for the argument. The residual returns from Fama-French 3-factor model are adopted instead of total return, and the result is robust in this change.

$$R_{it} = \alpha_i + r_f + \beta_{1,it}(r_{m,t} - r_f) + \beta_{2,it} SMB_t + \beta_{3,it} HML_t + \epsilon_{it} \quad (3)$$

$$RR_i = \sum_i \epsilon_{it} \quad (4)$$

$r_{m,t}$ is the market return at time t, and r_f is the risk-free rate. $\beta_{1,it}$, $\beta_{2,it}$ and $\beta_{3,it}$ are factors of market premium, size premium, and value premium. This study notes the sum of residuals as residual return RR_i.

During this process, the Fama-French 3-factor model is implemented, which regresses the return premium to market premium, size premium and value premium. The residual returns are calculated by the arithmetic sum of residual regardless of compounding. The reason that why this study does not adopt abnormal returns as BHAR in (5) with compounding is that this would accumulate errors in expected returns and make abnormal returns unrealistic large. When BHAR is used, normally benchmark is calculated by a portfolio's return with the similar beta, size effect and value effect.

$$BHAR_i = \sum_i R_{it} - \sum_i (Benchmark_{it}) = \sum_i R_{it} - \sum_i (R_{it} - \epsilon_{it}) \quad (5)$$

After this, this study attempts to form implementable portfolios by surprises deciles and other factors. During the process, we will find that the relation between surprises and the returns is non-linear to some degree. There is convexity in the relation, which is revealed as U-shape in the plots. This study investigates this phenomenon by examining three fundamental risk factors, beta, size effect and value effect, in different surprises portfolios.

4. DATA SAMPLE

The 2008-2016 daily stock price data is obtained from CRPS database, combined with the data of market premium, SMB and HML from the Fama-French daily database (Kenneth R. French Data Library). The size, book-to-market ratio, and accounting accruals are calculated from quarterly corporate fundamental data in Compustat, and the actual EPS and EPS analysts' forecast are obtained from I/B/E/S. All the records are merged by 8-digit CUSIP expect Compustat need to be converted from 9-digit CUSIP to 8-digit CUSIP. In addition, two dummy

variables, Transaction-day and Transaction-time, are constructed from I/B/E/S database. Transaction-day indicates whether the earnings announcement published in a transaction day (1=yes, 0=no), and Transaction-time shows whether the earnings announcement published at a transaction time in a transaction day (1=yes, 0=no).

Table-1. Summary of Variables

Variable	Mean	Std. Dev.	25%	Median	75%
R1	0.1110	0.7095	-0.2503	0.0506	0.3561
R2	0.2954	1.0339	-0.2032	0.1141	0.5321
R3	0.4385	1.1893	-0.1570	0.2398	0.7297
Residual R1	0.0188	1.0567	-0.2041	0.0142	0.2473
Surprise	-0.0251	0.5977	-0.0034	0.0004	0.0034
Size	1.032E+04	8.199E+04	2.630E+02	9.499E+02	3.294E+03
BtoM	0.8003	1.3448	0.3403	0.6086	0.9888
Beta1	1.0541	0.6352	0.7893	1.0678	1.3607
Beta2	0.6524	1.3082	0.1815	0.6829	1.1299
Beta3	0.1783	1.2884	-0.2433	0.0379	0.4680
Accruals	-0.0087	1.2497	-0.2237	0.0015	0.2268
Mom	0.0779	1.6103	-0.3997	-0.1010	0.2592
Dvol	1.1133	9.7524	0.1130	0.5538	1.2234
T-day	0.9978	0.0470	1.0000	1.0000	1.0000
T-hour	0.3740	0.4839	0.0000	0.0000	1.0000

Table 1 gives descriptive statistics for variables. The Surprise variable is calculated as the difference between I/B/E/S forecast EPS minus I/B/E/S actual EPS, scaled by stock price. R1, R2, and R3 are respectively the total returns of the firm, beginning one day after the earning announcements and extending one year, two years and three years into futures. Residual R1 is the one-year cumulative residual returns, in which the residuals are calculated from Fama-French 3-factor model. The market premium, SML, and HML in Fama-French 3-factor model are obtained from Kenneth R. French Data Library. The Size variable is the total asset from COMPUSTAT, and the BtoM is short for Book-to-Market Ratio, which is the book value of assets minus book value of liabilities, divided by the close price of the quarter times the total outstanding common shares. Beta1, Beta2, and Beta3 are three factors in Fama-French 3-factor model. Transaction-day is a dummy to show whether the announcement is on the transaction day, and Transaction-hour is a dummy to show whether the announcement is in trading hours, which are from 9:00 to 16:30. Mom is the Momentum measured by market-adjusted return one quarter prior to the announcement. Dvol is the percentage volume change of three days around the announcement against three days prior. Accruals are measured in a change of current asset less the cash divided by current liability less the interest-bearing debt inside.

The returns are positive for one year and increasingly positive for two years and three years ahead; the medians are increasingly positive too. The one-year residual returns are less than one-year return on average, but they are more volatile than one-year returns. The median surprise is near zero that means the firms met the forecasts in the sample period. Although the mean of surprises is slightly negative, the distribution of surprises is almost symmetric when considering the first and third quartile. The size of the firm is largely positively skewed; the accruals are relatively symmetric. In Table 2, all the independent variables are not highly correlated, which rules out the possibility of multicollinearity.

Table-2. Correlations of Variables

	Surprise	Size	BtoM	Beta1	Accruals	Mom	Dvol	T-day	T-hour
Surprise	1.000								
Size	0.008	1.000							
BtoM	-0.170	-0.014	1.000						
Beta1	-0.006	0.013	-0.022	1.000					
Accruals	0.008	0.001	-0.022	-0.009	1.000				
Mom	0.018	-0.014	-0.087	0.020	0.003	1.000			
Dvol	0.000	-0.015	0.009	0.001	0.002	-0.006	1.000		
Transaction Day	0.006	0.009	-0.015	0.003	0.004	0.001	0.001	1.000	
Transaction Hour	0.011	-0.075	-0.035	-0.046	0.002	0.000	0.004	0.012	1.000

5. REGRESSION RESULT

Table-3. Estimated Coefficients from the Basic Regressions of Returns on Surprises

	(1)	(2)	(3)
Variable	**R1**	**R2**	**R3**
Surprise	0.255***	0.214***	0.255***
	(0.0145)	(0.0232)	(0.0270)
Beta	0.0684***	0.0995***	0.0580**
	(0.0131)	(0.0204)	(0.0241)
Size	-0.108***	-0.239***	-0.277***
	(0.0114)	(0.0177)	(0.0232)
Btom	0.159***	0.249***	0.214***
	(0.0147)	(0.0225)	(0.0264)
Constant	-0.0740***	0.140***	0.324***
	(0.0126)	(0.0208)	(0.0250)
R-squared	0.019	0.014	0.011

The robust standard deviation is reported in the regression. *, ** and *** show the 10%, 5% and 1% significance.

The following regressions are using the procedure of decile ranking (Fama and MacBeth, 1973) and robust variance to control for heteroskedasticity (Huber, 1967; White, 1980; White, 1982). The surprise, beta, size and book-to-market variables are assigned to a portfolio numbered from 0 to 9 based on the cutoff between deciles from the previous quarter. The portfolio number is then divided by nine to yield a variable that lies between 0 and 1. The robust standard deviation is reported in the regression. In Table 3, the risk proxies, beta, size, and book-to-market are significant to the returns for one year, two years and three years. The beta and size are positively correlated to future returns, while the size is negatively correlated to future returns, which is consistent with Fama French's view. The coefficients on surprises are significantly 0.2540, 0.2154 and 0.2580 for one, two and three years. Consistent with Doyle *et al.* (2006) the earnings announcement surprises have a longer impact than people's imagination.

Table-4. The Distribution of Firms in Different Industry Sectors in the Total sample, Top and Bottom Surprise Decile

	SIC Sectors	% of Top Surprise Portfolio	% of Total Sample	% of Bottom Surprise Portfolio
	Agriculture, Forestry, Fishing			
1	Agricultural Production Crops	0.002	0.002	0.003
2	Agriculture production livestock and animal specialties	0.000	0.001	0.002
7	Agricultural Services	0.000	0.000	0.000
	Mining			
10	Metal Mining	0.004	0.005	0.007
12	Coal Mining	0.003	0.004	0.002
13	Oil And Gas Extraction	0.034	0.039	0.047

14	Mining And Quarrying Of Nonmetallic Minerals, Except Fuels	0.000	0.002	0.000
	Construction			
15	Building Construction General Contractors And Operative Builders	0.006	0.005	0.025
16	Heavy Construction Other Than Building Construction Contractors	0.003	0.004	0.002
17	Construction Special Trade Contractors	0.002	0.003	0.003
	Manufacturing			
20	Food And Kindred Products	0.011	0.018	0.023
21	Tobacco Products	0.000	0.001	0.000
22	Textile Mill Products	0.002	0.002	0.002
23	Apparel And Other Finished Products Made From Fabrics And Similar Materials	0.006	0.006	0.002
24	Lumber And Wood Products, Except Furniture	0.006	0.004	0.007
25	Furniture And Fixtures	0.005	0.005	0.004
26	Paper And Allied Products	0.009	0.008	0.008
27	Printing, Publishing, And Allied Industries	0.008	0.006	0.006
28	Chemicals And Allied Products	0.153	0.087	0.076
29	Petroleum Refining And Related Industries	0.009	0.008	0.015
30	Rubber And Miscellaneous Plastics Products	0.010	0.007	0.007
31	Leather And Leather Products	0.005	0.004	0.003
32	Stone, Clay, Glass, And Concrete Products	0.003	0.004	0.004
33	Primary Metal Industries	0.012	0.012	0.013
34	Fabricated Metal Products, Except Machinery And Transportation Equipment	0.010	0.010	0.006
35	Industrial And Commercial Machinery And Computer Equipment	0.040	0.047	0.029
36	Electronic And Other Electrical Equipment And Components, Except Computer Equipment	0.091	0.075	0.068
37	Transportation Equipment	0.029	0.020	0.017
38	Measuring, Analyzing, And Controlling Instruments; Photographic, Medical And Optical Goods; Watches And Clocks	0.040	0.056	0.049
39	Miscellaneous Manufacturing Industries	0.010	0.007	0.006
	Transportation & Public Utilities			
40	Railroad Transportation	0.000	0.002	0.000
41	Local And Suburban Transit And Interurban Highway Passenger Transportation	0.001	0.001	0.000
42	Motor Freight Transportation And Warehousing	0.002	0.007	0.007
44	Water Transportation	0.016	0.011	0.013
45	Transportation By Air	0.012	0.008	0.009
46	Pipelines, Except Natural Gas	0.000	0.002	0.000
47	Transportation Services	0.002	0.004	0.002
48	Communications	0.037	0.028	0.031
49	Electric, Gas, And Sanitary Services	0.015	0.038	0.011
	Wholesale Trade			
50	Wholesale Trade-durable Goods	0.009	0.015	0.013
51	Wholesale Trade-non-durable Goods	0.006	0.009	0.004
	Retail Trade			
52	Building Materials, Hardware, Garden Supply, And Mobile Home Dealers	0.000	0.001	0.000
53	General Merchandise Stores	0.006	0.005	0.001
54	Food Stores	0.003	0.003	0.002
55	Automotive Dealers And Gasoline Service Stations	0.008	0.006	0.007
56	Apparel And Accessory Stores	0.014	0.011	0.006
57	Home Furniture, Furnishings, And Equipment Stores	0.006	0.004	0.006
58	Eating And Drinking Places	0.010	0.012	0.005
59	Miscellaneous Retail	0.016	0.017	0.022
	Finance, Insurance, Real Estate			
60	Depository Institutions	0.081	0.094	0.193
61	Non-depository Credit Institutions	0.017	0.008	0.019
62	Security And Commodity Brokers, Dealers, Exchanges, And Services	0.009	0.017	0.016
63	Insurance Carriers	0.041	0.033	0.044
64	Insurance Agents, Brokers, And Service	0.002	0.004	0.001

65	Real Estate	0.007	0.005	0.012
67	Holding And Other Investment Offices	0.044	0.045	0.038
	Services			
70	Hotels, Rooming Houses, Camps, And Other Lodging Places	0.004	0.003	0.003
72	Personal Services	0.002	0.003	0.002
73	Business Services	0.071	0.100	0.052
75	Automotive Repair, Services, And Parking	0.003	0.002	0.001
76	Miscellaneous Repair Services	0.000	0.000	0.000
78	Motion Pictures	0.002	0.003	0.004
79	Amusement And Recreation Services	0.009	0.009	0.014
80	Health Services	0.009	0.016	0.009
81	Legal Services	0.000	0.000	0.000
82	Educational Services	0.001	0.007	0.003
83	Social Services	0.000	0.001	0.001
87	Engineering, Accounting, Research, Management, And Related Services	0.013	0.016	0.015
	Public Administration			
99	Nonclassifiable Establishments	0.001	0.001	0.001

In Table 4, two-digit SIC of companies is obtained from COMPUSTAT, and the sector name for each SIC is obtained from United States Department of Labor. The first and third columns are the percentages of firms in each sector inside first and last surprise deciles respectively. The second column is the percentages of firms in each sector of the total sample. Table 4 illustrates that the distribution of extreme surprise portfolios is stable across different industries. To be noticed, the announcements in chemicals and allied products industry are concentrated in the first surprises decile, which means chemicals and allied products did a relatively good job in the sample. In contrast, the depository institutions announced more bad news in the sample, probably because of the impact of GFC to banks in the US.

Table-5. Estimated Coefficients from the Main Regressions of Total Returns on all Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	**R1**	**R1**	**R1(exc2008.4)**	**R1(exc2008.4)**	**R2**	**R2(exc2008.4)**	**R3**	**R3(exc2008.4)**
Surprise	0.432***	0.293***	0.439***	0.286***	0.474***	0.497***	0.526***	0.566***
	(0.0478)	(0.0195)	(0.0495)	(0.0199)	(0.0753)	(0.0773)	(0.0982)	(0.102)
Beta	0.0304*	0.0317**	0.0195	0.0208	0.0336	0.0265	-0.0110	-0.0113
	(0.0157)	(0.0156)	(0.0161)	(0.0160)	(0.0246)	(0.0241)	(0.0297)	(0.0290)
Size	0.102***	-0.0505***	0.0875***	-0.0531***	-0.00442	-0.00386	-0.0262	-0.0295
	(0.0250)	(0.0130)	(0.0259)	(0.0134)	(0.0404)	(0.0410)	(0.0523)	(0.0518)
BtoM	0.243***	0.221***	0.296***	0.249***	0.231***	0.283***	0.196***	0.268***
	(0.0299)	(0.0189)	(0.0291)	(0.0187)	(0.0490)	(0.0481)	(0.0634)	(0.0628)
Size x Surprise	-0.299***		-0.272***		-0.283***	-0.260***	-0.366***	-0.328***
	(0.0526)		(0.0543)		(0.0814)	(0.0824)	(0.108)	(0.104)
BtoM x Surprise	-0.0418		-0.0895		-0.0398	-0.126	-0.0465	-0.165
	(0.0686)		(0.0691)		(0.111)	(0.106)	(0.133)	(0.129)
Transaction-day	0.0844	0.0830	0.0767	0.0758	0.0585	0.0543	0.251**	0.232**
	(0.0615)	(0.0621)	(0.0599)	(0.0605)	(0.0953)	(0.0948)	(0.107)	(0.107)
Transaction-hour	0.0284***	0.0286***	0.0297***	0.0298***	0.0267*	0.0235*	0.0167	0.0134
	(0.00911)	(0.00911)	(0.00926)	(0.00926)	(0.0140)	(0.0140)	(0.0172)	(0.0170)
Mom	-0.261***	-0.264***	-0.153***	-0.156***	-0.826***	-0.713***	-0.652***	-0.565***
	(0.0201)	(0.0202)	(0.0215)	(0.0216)	(0.0311)	(0.0328)	(0.0357)	(0.0372)
Accruals	-0.103***	-0.101***	-0.104***	-0.103***	-0.127***	-0.119***	-0.105***	-0.102***
	(0.0115)	(0.0115)	(0.0114)	(0.0114)	(0.0173)	(0.0173)	(0.0207)	(0.0212)
Constant	-0.0642	0.00752	-0.145**	-0.0662	0.503***	0.403***	0.401***	0.325***
	(0.0654)	(0.0644)	(0.0638)	(0.0631)	(0.103)	(0.101)	(0.118)	(0.117)
R-squared	0.040	0.039	0.037	0.036	0.072	0.064	0.038	0.034

The robust standard deviations are in parentheses. *, ** and *** show the 10%, 5% and 1% significance. Columns (3), (4), (6) and (8) are regressions excluding the third quarter of 2008.

Main regressions are shown in Table 5. Under different conditions, the coefficients on surprises deciles are significantly positive and increase across the investment horizon. We can see GFC, represented by the fourth quarter of 2008, drives the slope upward a little bit. The interaction of size and surprises is significantly negative, which is consistent with the idea that large firms have a lower impact of earnings surprises. However, to my surprise, the interaction between surprises and the book-to-market ratio is not significant in contrast to Skinner and Sloan (2002). Accounting accruals are significantly negative, and this coincides with the income quality measure role of accruals. The high accruals mean the firm overdraws the future income, which does harm to the stock price. The dummy variables transaction-day and transaction-hour do not keep significant across all conditions. However, in some situations, it still shows that publishing EPS on transaction hours and publishing on transaction days will do good impact on future returns, which coincide with the idea that off-trade announcement benefits the short-term returns, but harms the long-term returns. Dellavigna and Pollet (2009) the change in volume around the announcement date is not significantly correlated with returns.

To examine the dummy variables, transaction day and transaction time, Figure 1 shows that the distribution of surprises given the dummy variables. In Column 1, we can see that the distribution of surprises in non-transaction days is more negatively skewed with more negative mean than in transaction days. The situation is similar in transaction times. In other words, in the non-transaction day or at the non-transaction time, firms tend to announce the worse news. But the result in Table 5 shows that these techniques that firms put the bad news announcement into non-trading time or day do not help mitigate the negative impact of news too much because the coefficients on transaction day and transaction time in Table 5 are not significant across all regressions.

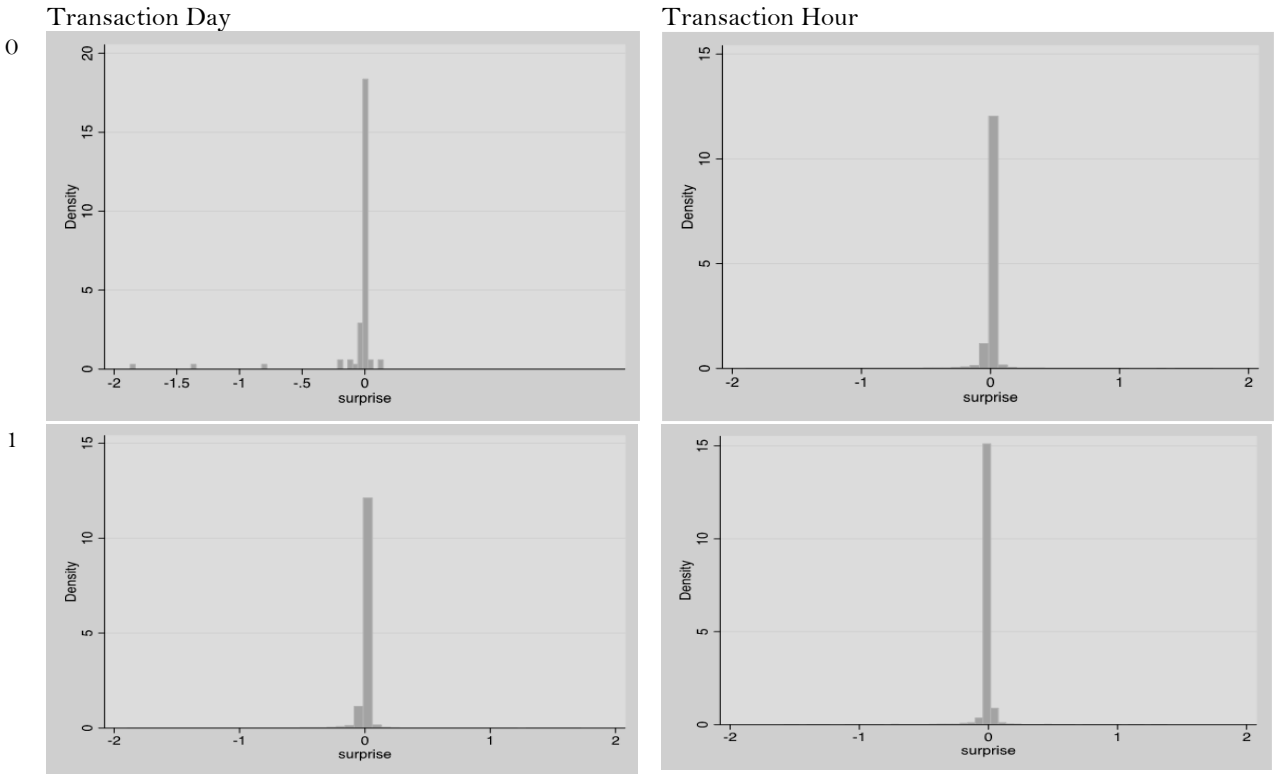


Figure-1. Distribution of Surprise in Different Values of Transaction Day or Transaction Time

Zero means the earnings announcement is not in a transaction day (In Column 1) or not at a transaction time (In Column 2). 1 means the earnings announcement is in a transaction day (In Column 1) or at a transaction time (In Column 2).

For the robustness, one-year residual returns from Fama-French 3-factor model replace the total return in Table 6. Because Fama-French model has already taken the beta effect, size effect and growth effect into consideration, this study does not consider these effects again in the regression. In the first row, earnings surprises are significant. The size interaction and momentum are significant as same as last regression. However, to my

surprise, the growth interaction becomes significantly positive, which means the value firms react more to the one-year residual return. The accruals seem to be insignificant in the regression of residual returns, but after control of fixed effect and first-order autocorrelation (Baltagi and Wu, 1999) the coefficient becomes significant under 10% level again. The coefficients of transaction day and transaction time are insignificant, which double checks the argument that the techniques that firms put the bad news announcement into non-trading time or day do not help mitigate the negative impact of news too much.

Table-6. Regressions of Residual Returns on all Variables

	(1)	(2)	(3)
Variable	**Residual R1**	**Residual R1(exclude 2008.4)**	**Residual R1(AR(1), FE)**
Surprise	0.311***	0.328***	0.0789**
	(0.0411)	(0.0443)	(0.0380)
Size x Surprise	-0.247***	-0.288***	-0.342***
	(0.0476)	(0.0511)	(0.0561)
BtoM x Surprise	0.127***	0.136***	0.219***
	(0.0464)	(0.0495)	(0.0464)
Transaction-day	0.133	0.142	-0.126
	(0.0934)	(0.0957)	(0.102)
Transaction-hour	0.000984	-0.0105	-0.0232
	(0.0160)	(0.0172)	(0.0159)
Mom	-0.376***	-0.320***	-0.421***
	(0.0290)	(0.0316)	(0.0252)
Accruals	-0.0132	0.00258	-0.0242*
	(0.0198)	(0.0213)	(0.0140)
Constant	-0.0824	-0.125	0.354***
	(0.0953)	(0.0978)	(0.0401)
R-squared	0.020	0.018	
rho_ar			0.6194
sigma_u			0.9010
sigma_e			0.6732
rho_fov			0.6418
Number of firms			2,658

The robust standard deviations are in parentheses. *, ** and *** show the 10%, 5% and 1% significance. Columns (2) shows the regression excluding the third quarter of 2008. Columns (3) shows the regression with fixed effect and AR(1).

6. PORTFOLIO CONSTRUCTION

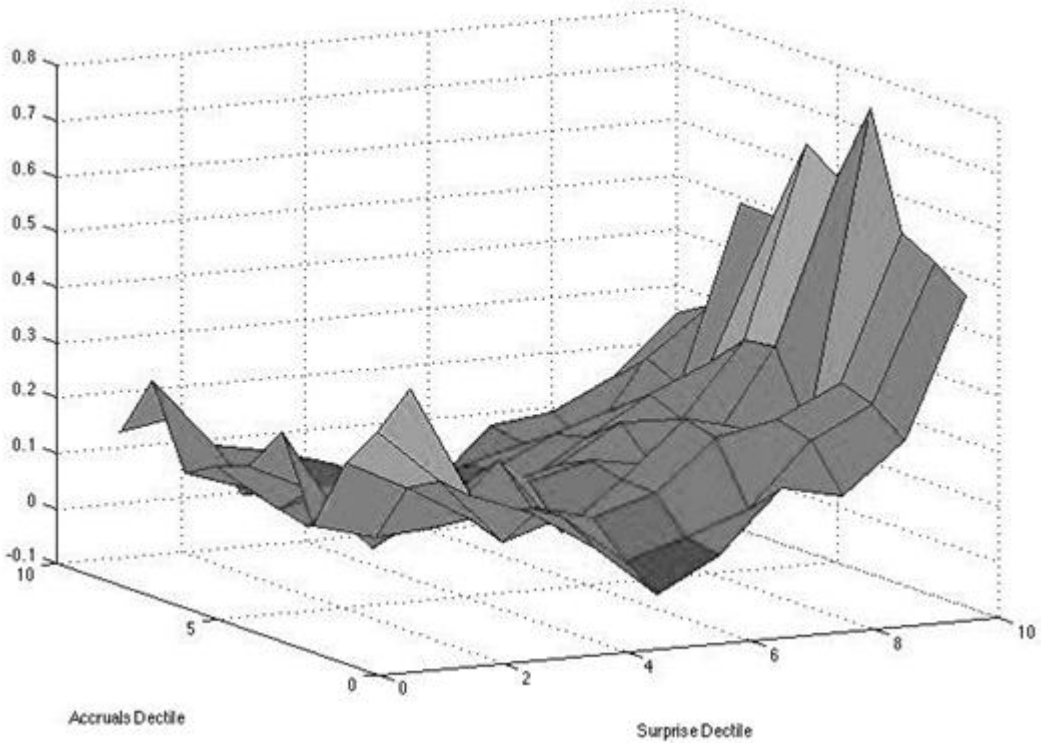
In this section, we attempt to form an easily implementable portfolio construction method to yield the impact of surprises. After conducting trial and error procedure by constructing portfolios of significant variables, this study uses two variables, surprises variable, and accruals variable, to form portfolios. According to the previous study, these two variables are two of the most robust factors to post-earnings announcements drift.

First, this study attempts to construct portfolio without hedging the risk, and only focus on total returns. Owing to the high impact of accruals on returns, this study combines accruals deciles with surprises deciles. However, we will soon find out that this portfolio performance is highly contingent upon the risk factors rather than the surprises effect. In the second step, this study adopts residual returns to hedge the beta, size and growth factors.

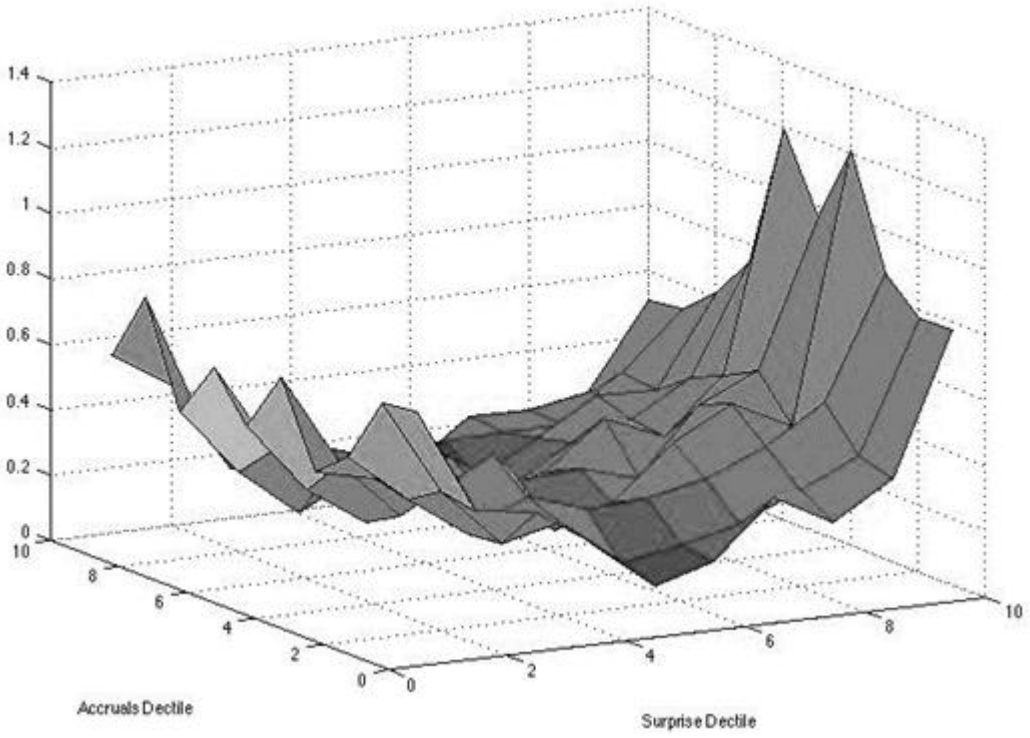
In Panel A and B of Figure 2, the one-year and two-year total returns are plotted against deciles of surprises and accruals. To my surprise, the surface is U-shape rather than a slope, which implies "no news means bad news." However, if we inspect relation of residual returns, surprises and accruals in the Panel C, U-shape disappears, which shows that after hedging the risks surprises and accruals have a smoother impact on returns. To explain why there

are U-shape surfaces in the Panel A and Panel B, a plot of risks factors in different surprises portfolios are checked in Figure 3. This non-linearity is consistent with previous literature (Freeman and Tse, 1992; Hayn, 1995; Skinner and Sloan, 2002).

Panel A: One-year total return



Panel B: Two-year total return



Panel C: One-year residual return

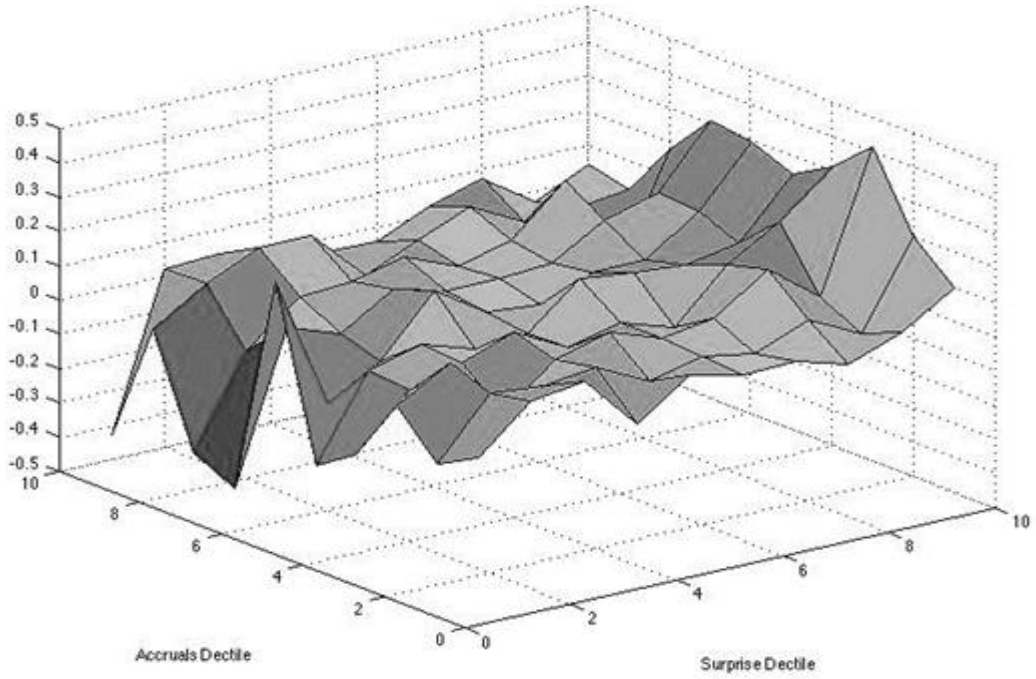
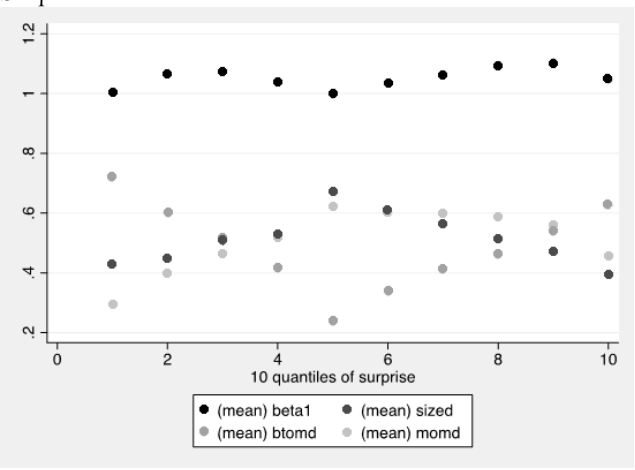


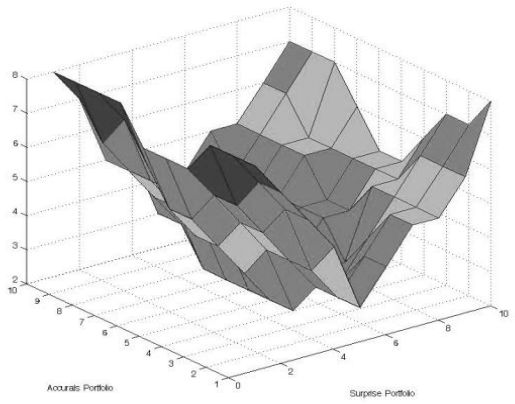
Figure-2. One-year Return Plots of Surprises and Accruals Portfolios

The figures show that 3D plots of one year return, two-year returns and one-year residual returns against accruals deciles and surprises deciles, which means the returns of 100 portfolios from different surprises deciles and accruals deciles are calculated and shown.

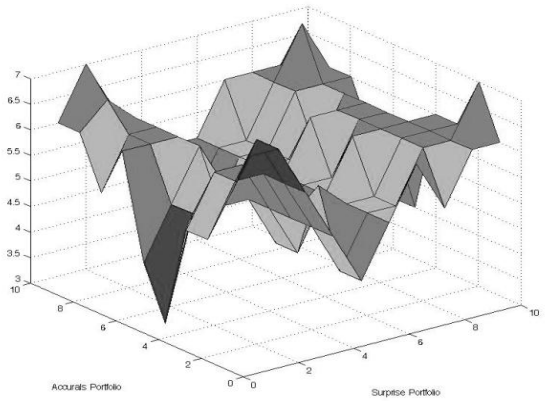
A: Risk (Beta, Size, BtoM, and Momentum) against Surprises



C: Size of Surprises and Accruals



B: Beta against Surprises and Accruals



D: BtoM against Surprises and Accruals

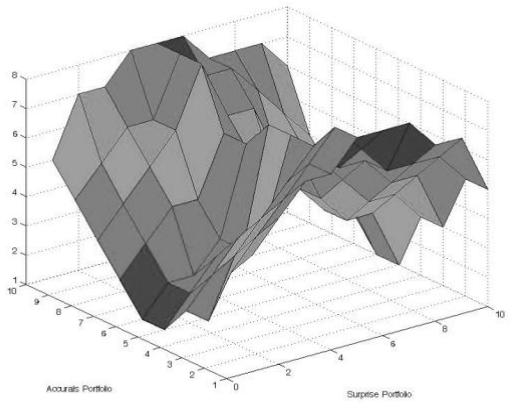


Figure-3. The Risk Factor Plot against Surprises or Surprises & Accruals

Panel A shows how four risk factors vary across different surprises deciles. Panel B, Panel C, and Panel D show the plot of Beta, Size, and BtoM across joint portfolios of surprises and accruals. All variables are measured in deciles in Panel B, Panel C, and Panel D.

In Panel A of Figure 3, three risk factors including size, growth, and momentum are very volatile across different surprises portfolios. The "no news" portfolio, which is the fifth surprises decile, has obviously big size, high momentum, and high growth. Panel B, C, and D show the three risk factors across different surprises-accruals portfolios. The beta plot has an M-shaped surface, the size plot has a V-shaped surface and book-to-market plot has a saddle shape. The variation in four panels explains why we require risk control in our portfolio construction.

The surprises portfolios and surprises-accruals combined portfolios have a high deviation in risks. Therefore, it is not proper to form a portfolio without considering the risk. The residual returns can be considered to be the hedged returns without the risk of beta, size, and growth. In practice, the way to get residual returns is short-selling a diversified portfolio with the same beta, size, and growth as the unhedged portfolio.

In Table 7, the high residual returns concentrate in the upper part of the last column, while the lowest residual returns concentrate in lower part of the first column. The strategy is to long the lower half accruals-top surprises portfolio and short the higher half accruals-bottom surprises portfolio, and hedge the risks (beta, size, and growth). The hedged return is 50.03% per year without the impact of beta, size, and growth.

In order to exploit the earnings surprises and accruals in the real world, implementability factors should be concerned. Implementability factors include unavoidable factors (price pressure and short sales) and avoidable factors (maximum stake size, maximum portfolio weight constraint and minimum price constraint). For example, price impact adjustments, 5% block holding constraints (Investors holding more than 5% suffer from stricter regulation Section 2(a) of the Investment Company Act of 1940), and avoidance of securities with large expected price impacts have large negative effects on portfolio returns for most strategies. To implement this strategy in the real world, more study should be done before taking it into the market.

Table-7. Residual Returns in Different Surprises-Accruals Portfolios

Accruals\Surprises	1	2	3	4	5	6	7	8	9	10
1	-0.0825	0.0454	0.0721	-0.0908	0.0198	-0.0168	-0.0169	-0.0539	0.0029	0.0979
2	-0.1612	0.0291	0.0097	0.0327	-0.0469	-0.0156	-0.0389	0.0244	-0.0561	0.2102
3	-0.0473	0.0644	-0.1231	0.0067	0.0512	-0.0009	0.0227	0.1289	0.014	0.421
4	-0.214	-0.0585	-0.0155	0.0347	-0.0426	0.0011	-0.0497	0.0894	0.1932	0.3138
5	-0.3152	-0.0137	-0.0081	-0.0553	-0.0399	0.0809	0.0594	0.0555	0.0763	0.2331
6	0.2057	-0.1926	-0.1001	0.0716	-0.0272	-0.0386	0.017	0.0206	0.1317	0.2905
7	-0.4622	-0.0051	-0.0625	0.029	-0.0091	-0.0084	-0.0007	0.0905	0.1298	0.3121
8	-0.4254	-0.1269	-0.0135	0.0048	0.0402	-0.02	0.0218	0.169	-0.1182	0.182
9	-0.0894	0.0174	0.0709	0.0912	-0.0566	0.0107	0.0747	-0.0041	0.0026	0.0133
10	-0.4544	0.0204	0.028	-0.0248	-0.0367	-0.0434	0.0228	0.0708	-0.0296	0.0459

The dark color shows the highest residual returns and the light color shows the lowest returns. The hedged portfolio is constructed by longing the stocks framed by the up left the bold box and shorting the ones framed in the downright bold box.

7. CONCLUSION

An earnings surprise is the difference between the reported earnings and the expected earnings of an entity. Stock markets tend to react in the same direction as earnings surprises—positively to positive earnings surprises and negatively to negative earnings surprises. This study investigates the earnings surprises drift in recent years (2008-2016) with two main targets: The first one is to describe the relationship between returns and the surprises together with the interaction of size, growth, momentum, accounting accruals, and timing. The second target is to develop an implementable-hedged portfolio to exploit the post-earnings announcement drift.

After investigating both total returns and Fama-French residual returns by using both the portfolio method and Fama-Macbeth regression, we come to the following conclusions:

First, this study discusses the determinants of post-earnings announcement drift. Earnings surprises have a significantly positive impact on both returns (1-3 years) and residual returns (1 year). The interaction between size and surprises is significantly negative in all conditions, but the interaction between book-to-market ratio and surprises is significant only when considering the residual returns. The changes in volume and the timing (including both date and time) do not keep significant in all cases. Therefore, the techniques that firms put the bad news announcement into non-trading time or day do not help mitigate the negative impact of news too much, and the volume is not a market microstructure predictor of the earnings announcement impact. The accruals are significantly negatively correlated with both returns and residual returns.

Second, this study explores the cross-sector variations of surprises. The proportions of each sector within the whole sample, the top, and the bottom decile are the same. So the distribution of surprises is quite flat across different industry sectors.

Third, this study exploits the impact on returns of surprises and accruals in portfolio construction. The different surprises deciles have different risk levels, including size, growth, and momentum. Therefore, it is not proper to leave the target portfolio unhedged. After controlling the beta, size, and growth, the hedged portfolio built by buying the lower half accruals-top surprises portfolio, and short selling the higher half accruals-bottom surprises portfolio can generate a 50.03% return.

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