Macrothink Institute™

Business and Economic Research
ISSN 2162-4860
2015, Vol. 5, No. 2

Earnings Smoothing, Momentum and Statistical Arbitrage: Global Evidence

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Received: May 26, 2015 Accepted: June 14, 2015

doi:10.5296/ber.v5i2.7938 URL: http://dx.doi.org/10.5296/ber.v5i2.7938

Abstract

We employ the notion of statistical arbitrage to investigate the relationship between earnings smoothing and returns from momentum trading of stocks and explore the role that the level of investor sophistication may play in the smoothing-return calculus. To do so, we exploit the observation that both earnings smoothing and momentum profits are related to the cross-sectional variation in returns. We analyze the relevant data of 25 developed and emerging economies. Our results confirm the proposition that momentum profits as indicated by statistical arbitrage measures are inversely related to earnings smoothing but only in those markets where investors are more sophisticated and are able to take advantage of liquidity traders, who are often uninformed.

Keywords: Statistical arbitrage, momentum, Stock comovement, Investor sophistication, Earnings smoothing

1. Introduction

According to Beidleman (1973) earnings smoothing occurs when managers intentionally use their reporting discretion to reduce the volatility of their firms' reported earnings. This intertemporal smoothing may be accomplished using both "artificial" and "real" means. Artificial smoothing occurs when managers shift earnings from one period to another using the built-in flexibility typically afforded them by their country's legal and accounting systems while not affecting any period's cash flow. In contrast, real smoothing occurs when the actual cash flows change. Smoothing can be accomplished in a variety of ways, including the propitious scheduling of investments, developing marketing strategies that speed up or slow down sales toward the end of a reporting period, and financing risky accounts receivables. Goel & Thakor (2003) among others point out that both types of smoothing are costly because real smoothing directly reduces firm value while artificial smoothing affects value through the loss of manager credibility and administrative expenses.

It is well-documented that managers engage in this activity (e.g., Moses, 1987; Bannister & Newman, 1996; and Subramanyan, 1996, to name but three studies in a long list.). Although smoothing is an international phenomenon, Leuz, Nanda & Wysocki (2003) report that it is more pronounced in some countries than in others. Many reasons have been offered to explain why managers smooth reported earnings. They include managerial self-interest (e.g, Lambert, 1984; Fudenberg & Tirole, 1995), signaling firm value (e.g., Dye, 1988; Tucker & Zarowin, 2005)), bankruptcy concerns (e.g., Trueman &Titman, 1988), and tax incentives (e.g., Rozycki, 1997). Although these factors undoubtedly provide some explanation, Moses (1987), Goel & Thakor (2003), Tucker & Zarowin (2006) and numerous others suggest that managers smooth earnings to support liquidity trading.[1]

In commenting on liquidity trading, Goel and Thakor (2003) argue that greater earnings volatility gives informed investors a profit advantage over liquidity (uninformed) traders, thereby causing the latter to want managers to smooth earnings. Their argument is supported by Dey (2004), who empirically demonstrates that sophisticated (informed) investors tend to invest less in firms that actively smooth earnings. Wang (2006) documents that the market overreacts to bad news but that it underreacts to good news, most likely because managers tend to smooth earnings by hiding bad news and spreading good news over time. Building on the work of Daniel, Hirshleifer & Subrahmanyam (2001), Jiang (2005, 2006) shows that when a large number of overconfident (informed) investors overreact to earnings news, the cross-sectional dispersion of firm valuations widens because of mispricing by these investors and this widening, in turn, increases the cross-sectional dispersion of returns. These studies support the notion that earnings smoothing and cross-sectional dispersion of returns are linked and that this linkage depends on the amount of trading by informed investors.

[1] See Chew et al. (2004) for a roundtable by academics and practitioners concerning the practice of earnings smoothing in the context of corporate disclosure.

Although earnings smoothing has been widely documented and analyzed, its direct impact on trading strategies has received much less attention.[2] As a partial remedy, in this paper we investigate the impact of earnings smoothing on momentum trading strategies and the manner in which this impact depends on the market's sophistication (informedness). Momentum strategies involve the buying of prior winners and the selling of prior losers. These long-short strategies have historically provided statistically and economically significant profits in the U.S. (e.g., Jegadeesh & Titman, 1993; George & Hwang, 2004; and Novy-Marx, 2012) and other major stock markets (e.g., Rouwenhorst, 1998, 1999; Liew & Vassalou, 2002; Griffin, Ji & Martin, 2003; and Asness, Moskowitz & Pedersen, 2013). Lo & MacKinlay (1990) and others point out that these profits, by construction, are a function of the cross-sectional variation in returns such that as the cross-sectional variation increases, momentum profits increase. Moreover, although other factors have been found to affect momentum profits, the cross-sectional dispersion of returns is one of the primary drivers.[3]

Based on the documented links (1) between earnings smoothing and cross-sectional variation in returns and (2) between cross-sectional variation in returns and momentum profits, we hypothesize that in sophisticated (informed) markets an increase in earnings smoothing should be associated with a decrease in the probability of momentum-based statistical arbitrage. We investigate this proposition using data from 19 developed markets and six emerging ones. Our results from the 25 countries show that momentum profits decrease with earnings smoothing but only when investors are as a group relatively more sophisticated (informed).

2. Model and Hypothesis

In an ideal market, managers reveal firm-specific information to the market instantaneously, and investors immediately impound this information in stock prices. Any distortion of this process affects the informativeness of stock prices and trading strategies. We break up distortions to information flow into two parts: (1) distortions arising from the ability of the investment audience to comprehend the value of firm-specific information, and (2) distortions resulting from manager activities, such as earnings smoothing. These two types of distortions need not be independent of each other. For instance, proponents of earnings smoothing often argue that information distortion from this source helps investors evaluate companies in a less

[2] For example, Chan, Jegadeesh & Lakonishok (1996) show that return momentum coexists with earnings momentum. Chordia & Shivakumar (2006) show that earnings momentum and price momentum are related and suggest that price momentum is the result of earnings momentum since earnings momentum occurs when firms that report unexpected high profits subsequently perform better than those that report unexpected low profits. Moreover, Myers, Myers & Skinner (2007) link the presence of earnings smoothing to earnings momentum. Novy-Marx (2015, p. 1) asserts that "… price momentum is merely a weak form of earnings momentum…".

[3] Momentum profits are also associated with several characteristics not typically included in asset pricing models. For example, Lee & Swaminathan (2000) indicate that momentum is more common in stocks with a high turnover. Hong, Lim & Stein (2000) show that small firms that have low analyst coverage exhibit more momentum. Grinblatt & Moskowitz (2004) report that momentum is more often observed not only for small firms with few institutional owners but also for growth firms and firms with high trading volume. Hvidkjaer (2006) associates the presence of a large number of small traders with momentum. In addition, Bandarchuk & Hilscher (2013) argue that if extreme past returns are considered a firm characteristic returns lose their explanatory power. Nevertheless, as of yet, research has been unable to attribute momentum profits to economy-wide factors. For instance, Liew & Vassalou (2002) find that the growth rate of Gross Domestic Product (GDP) cannot capture momentum strategy profitability, and Griffen, Ji & Martin (2003) demonstrate that differences in macroeconomic risk cannot explain the variability of this profitability among countries. More recently, Asness, Moskowitz & Pedersen (2013) report the presence of some sort of a global factor but indicate that it is only loosely linked to macroeconomic factors.

volatile environment. This does not necessarily imply that investors base their decisions on incorrect information but instead on less informative earnings, provided that they know that managers may engage in such activities. In our case, the combined effect of earnings smoothing and investor sophistication define the efficiency of information flow from companies to investors, and, therefore, not only determines a market's information (intelligence) environment but also impacts the cross-sectional variation in expected returns and, thus, the profitability of momentum strategies.

Our empirical hypothesis rests on the notion that in markets that are dominated by sophisticated investors, managers' earnings smoothing actions do not alter the fact that the price incorporates information in the reported (smoothed) earnings and real earnings. However, if investors are naïve and cannot comprehend what is hidden behind the smoothed earnings, then we expect a higher variation in expected returns because of the possibility that managers smooth earnings for opportunistic reasons such as postponing large losses by intertemporal smoothing.

We test this prediction using the following basic probit regression model:

$$P(MOM > 0) = \beta_0 + \beta_1 Smooth + \beta_2 DInvSoph + \beta_3 SmoothxDInvSoph + e \qquad (1)$$

where *MOM* is a binary variable where a value of one indicates the presence of momentum. *Smooth* is an earnings smoothing proxy, in which higher values represent lower earnings smoothing. *DInvSoph* is a binary variable that takes value of one if our proxy for investor sophistication is greater than its sample average and zero otherwise. *SmoothxDinvSoph* is an interaction term linking *Smooth* and *DInvSoph*. Finally, *e* is the conventional Gaussian error term with a zero mean. If our conjecture is valid, momentum profits should not decrease with earnings smoothing in sophisticated markets for all levels of earnings smoothing.

3. Data and Definitions

We use various data sources to test our conjectures regarding the relationship between momentum profits, earnings smoothing, and sophisticated (informed) investors. We also use several variables to control for the possibility that the relationship among our primary variables is not spurious. In this section, we define our measures and data sources.

3.1 Momentum Profits

To calculate returns to momentum we use monthly stock return data from 25 countries. Our data cover most of the developed markets as well as several emerging markets.[4] As shown in Table 1, the sample varies widely with the largest countries in terms of the number of companies being the U.K. (2496) and the U.S. (2293) and the smallest being the Denmark (52) and Ireland (57). The sample starting date for the countries also varies and ranges from 1965 for the U.S. to 1990 for India and the Philippines. For most countries the data begin in 1982, which is commonly considered to be the beginning of the global liberalization of

[4] We exclude some countries (such as Egypt, Argentina, Brazil, Peru, China, Taiwan, and Thailand) because there was not enough data to calculate momentum profits. Others are excluded because they have neither the requisite earnings smoothing measure nor investor sophistication measures.

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ISSN 2162-4860
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financial markets. The ending date is October 2013 for all countries save the U.S. which is one month later. Each country experiences a wide range of economic environment and shares the financial turmoil associated with the 2007 – 2009 global financial crisis.

Table 1 displays the sample starting dates for each country and the number of firms at the beginning of 1982 (or the first available month for countries when they are included in the sample), respectively. Our U.S. sample includes the common shares of all NYSE, AMEX and Nasdaq firms listed in the CRSP data base between January 1965 and November 2013. We exclude ADRs, SBIs, certificates, REITs, closed-end funds, companies incorporated outside the U.S., and Americus Trust Components to maintain consistency with other momentum studies. Moreover, to lessen possible microstructure effects, we eliminate observations of stocks with a price of less than USD 5. For non-U.S. data, we follow Griffin, Ji & Martin (2003) and select the countries from TSF Datastream International that have at least 50 regularly traded stocks after January 1982. We remove real estate trusts and investment companies from our international sample and improve reliability by following Ince & Porter's (2004) data cleaning procedures. We also exclude monthly returns above 500% and below -99% because such observations are highly unlikely unless there is a recording error. Our results, however, are not sensitive to this latter filtering procedure.

Table 1. Sample start dates and number of companies used in returns from momentum calculations and two market characteristics

Country	Sample Dates	Number of Companies	Development Status
Australia	11/15/1982 – 10/15/2013	173	Developed
Belgium	11/15/1982– 10/15/2013	76	Developed
Canada	11/15/1982– 10/15/2013	544	Developed
Denmark	11/15/1982– 10/15/2013	53	Developed
Finland	5/15/1988– 10/15/2013	71	Developed
France	11/15/1982– 10/15/2013	161	Developed
Germany	11/15/1982– 10/15/2013	229	Developed
Greece	2/15/1988– 10/15/2013	78	Developed
Hong Kong	11/15/1982– 10/15/2013	80	Emerging
India	2/15/1990– 10/15/2013	475	Emerging
Ireland	6/15/1987– 10/15/2013	57	Developed
Italy	11/15/1982– 10/15/2013	89	Developed
Japan	11/15/1982– 10/15/2013	988	Developed
Korea (South)	8/15/1984– 10/15/2013	312	Emerging
Malaysia	2/15/1986– 10/15/2013	190	Emerging
Netherlands	11/15/1982– 10/15/2013	223	Developed
Norway	11/15/1982– 10/15/2013	73	Developed
Philippines	1/15/1990– 10/15/2013	91	Emerging
Portugal	2/15/1988– 10/15/2013	69	Developed
South Africa	11/15/1982– 10/15/2013	71	Emerging
Spain	4/15/1987– 10/15/2013	72	Developed

Sweden	11/15/1982– 10/15/2013	102	Developed
Switzerland	11/15/1982– 10/15/2013	180	Developed
U.K.	11/15/1982– 10/15/2013	2496	Developed
U.S.	1/1/1965– 11/15/2013	2293	Developed

This table provides the beginning and ending dates and the number of stocks for the first portfolio available at the beginning of the sample for each country in our sample. The U.S. stock data are from CRSP and all other stock data are from Datastream. The table also displays whether the country is currently classified as having a developed or emerging economy as reported in *The Economist* (2011).

To calculate momentum profits, we follow a two-step approach. First, we employ the quantile strategy used by Jegadeesh & Titman (1993), although our subsequent results hold for a variety of other momentum strategies. Any momentum strategy consists of a ranking period in which winners and losers are identified, and an investment period in which winners are longed (bought) and losers are shorted (sold). To be compatible with numerous momentum studies, we use 6-month ranking and investment periods and create portfolios with equal weights. We follow this investment rule every month. Except for the U.S., we classify as winners those stocks in the top performance quintile and losers as those stocks in the bottom quintile. We use this classification grid because some countries do not have enough stocks to allow us to use the more common top and bottom decile classification scheme. For the U.S., however, we classify winners and losers by using the top and bottom performance deciles, respectively, to be consistent with other studies that use U.S. data, although using the top and bottom quintiles does not materially alter the results. To avoid possible transition distortions, we skip one month between the ranking and investment periods. Thus, for each month t, the portfolio (winner minus loser) held during the investment period months t to $t+5$, is determined by the performance of stocks during the ranking period, i.e., months $t-7$ to $t-2$. We denote such a strategy by “6/1/6”, where the first (second) “6” is the number of months in the ranking (investment) period and “1” represents the one-month transition period between the ranking and investment periods.

Second, we use the statistical arbitrage methods offered by Hogan et al. (2004), which we briefly outline in Appendix 1, to decompose momentum profits into momentum profit per month (μ) and the growth rate of volatility of momentum profits or exploitability risk (λ). We then categorize countries into two groups (those in which statistical arbitrage is present and those in which it is not) using these two measures. The idea underpinning this decomposition is similar to that of the intercept test of classical asset pricing models, except decomposition of the intercept term (winner minus loser profits in our case) allows us to study its time series behavior. In this framework, momentum profit per month (μ) represents the risk-free profit, provided that the volatility of the trading strategy (σ^2) quickly declines towards zero. The decline is governed by the second parameter (λ). For statistical arbitrage opportunities to be present, momentum profits per month should positive ($\mu > 0$) and the growth rate of volatility should be negative ($\lambda < 0$). A less (more) negative volatility growth rate means that the momentum portfolio’s profit is less (more) likely to be wiped out by fluctuations in the long and short holdings in the portfolio.

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ISSN 2162-4860
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We summarize the results of the 6/1/6 momentum strategy statistical arbitrage tests for 25 countries in Table 2. A review of this table shows that 21 λ estimates are negative and that 16 μ estimates are positive. Statistical arbitrage (both parameter estimates are of the proper sign) is found in almost half (12) of the countries. Using the joint test suggested by Hogan et al. (2004), statistical arbitrage, however, is only statistically significant for five countries at the 10% level or below, with four being developed markets (Finland, Italy, Norway and the U.K.) and one being an emerging market (India). Nevertheless, Hogan et al. (2004) indicate that their test is biased toward accepting the null hypothesis of no statistical arbitrage if the price process contains such features as autocorrelation, jumps or other potential non-stationary issues. Because one or more of these features are usually found in stock price processes, we believe that the number of instances of statistical arbitrage that we identify is greater than that indicated by their joint test. Nevertheless, for our measure of returns to momentum strategies (*MOM*), we use a binary variable that equals one if the significant statistical arbitrage possibilities are present in a market and zero otherwise.

Table 2. Statistical arbitrage tests for the 6/1/6 momentum strategy

This table summarizes the statistical arbitrage parameter estimates of the 6/1/6 momentum strategy as described in Appendix 1. The sample periods are reported in Table 1, with the number of months in the sample denoted by N. Statistical arbitrage profits are calculated for a 6-month ranking period and a 6-month investment period. Every month, stocks are sorted based on past six months of returns into quantile portfolios. The portfolio 6/1/6 longs the top quintile and shorts the bottom quintile (except the U.S. where we use the top and bottom deciles instead of quintiles) and holds that spread for six months. The risk-free asset is used to finance the portfolio. p_μ and p_λ denote the p-values associated with testing whether the portfolio's mean monthly incremental profit, μ, is positive and whether its time-averaged variance, as measured by λ declines over time. The sum of p_μ and p_λ is the p-value for Hogan et al.'s (2004) statistical arbitrage test. This sum may exceed one because of the Bonferonni inequality.

Country	μ	p_μ	λ	p_λ	$p_\mu + p_\lambda$	N
Australia	-0.048	1.243	-0.857	0.000	1.243	358
Belgium	0.795	0.000	0.490	1.000	1.000	358
Canada	-0.028	0.810	-0.235	0.001	0.811	358
Denmark	-0.424	1.142	-1.157	0.000	1.100	358
Finland	0.399	0.000	-0.205	0.026	0.026	298
France	0.028	0.490	-0.632	0.000	0.490	358
Germany	0.461	0.000	-0.032	0.390	0.390	358
Greece	-0.127	0.820	-0.785	0.000	0.820	286
Hong Kong	0.032	0.619	-0.218	0.000	0.619	358
India	0.280	0.072	-0.589	0.000	0.072	272
Ireland	0.144	0.181	-0.363	0.000	0.181	316
Italy	0.228	0.011	-0.458	0.000	0.011	358
Japan	-0.100	0.836	-0.047	0.395	1.231	358

Korea (South)	-0.105	1.250	-0.377	0.000	1.250	343
Malaysia	0.015	0.429	-0.251	0.004	0.433	320
Netherlands	0.496	0.080	0.087	0.679	0.759	346
Norway	0.159	0.004	-0.726	0.000	0.006	370
Philippines	-0.364	1.536	-0.261	0.001	1.537	286
Portugal	-0.106	0.897	-0.096	0.051	0.948	308
South Africa	-0.143	1.332	-0.914	0.000	1.332	370
Spain	0.242	0.144	0.230	0.002	0.146	318
Sweden	0.139	0.108	-0.072	0.086	0.195	358
Switzerland	0.602	0.000	0.077	0.837	0.837	358
U.K.	0.134	0.001	-0.372	0.003	0.004	358
U.S.	0.395	0.120	-0.204	0.000	0.219	574
Mean	0.126					
Std. Dev.	0.288		0.359			

3.2 Earnings Smoothing

We follow Leuz, Nanda & Wysocki (2003) to calculate earnings smoothing measures. The relevant financial accounting data are from 1990 to 2011 and is provided by three databases: Datastream WorldScope and Compustat Global Databases. Each measure involves operating income (*OpInc*), cash flow from operations (*CFO*) and accruals (*Acc*).[5] Because direct information on firms' cash flows is not obtainable for many countries, *CFO* is computed indirectly by subtracting the accrual component from earnings (*CFO* = *OpInc* – *Acc*). Prior to calculating the smoothing measures, *OpInc*, *CFO* and *Acc* are scaled by total assets lagged one period to account for firm size differences. The first earnings smoothing measure, *ES1*, is each country's annual median ratio of the firm-level standard deviation of *OpInc* to the firm-level standard deviation of *CFO*. The numerator of this ratio accounts for any differences in the variability of the economic performance among firms. Lower values of *ES1* indicate more income smoothing. The second measure, *ES2*, is the contemporaneous correlation between the change in *Acc* and the change in *CFO*. This measure assumes that reported income is smoothed by the variation in accruals offsetting the variation in cash flow from operations so that accounting accruals buffer cash flow shocks. This results in a negative correlation between changes in accruals and operating cash flows. Thus, more income smoothing is evinced by a lower (more negative) correlation values.

We provide the country values for *ES1* and *ES2* in Table 3. *ES1* ranges from 0.404 for South Korea to 0.784 for the U.S., with a mean of 0.594. The most negative *ES2* value is -0.980 for Greece and the least negative value is -0.759 for Norway and the U.S. The mean of *ES2* is -0.875. As we report in Table 3, the two earnings smoothing measures are highly correlated (0.911), with the U.S. exhibiting the least propensity to smooth earnings and Norway being a close second regardless of the measure used.

[5] Following Dechow, Sloan & Sweeney (1995), *Acc* is defined for firm *i* in year *t* as the change in total current assets, less the change in cash/cash equivalents, less the change in total current liabilities, plus the change in short term debt included in current liabilities, plus the change in income taxes payable, and less the change in depreciation and amortization expense. The change in short-term debt is excluded because it relates to financing transactions as opposed to operating activities.

Table 3. Variables

This table summarizes the explanatory data we use in the empirical tests. *ES1* and *ES2* are the earnings smoothing measures. *InvSoph* represents the investor sophistication level proxied by educational enrollment. *RSq* is the asset price comovement. *SC/GDP* is the ratio of stock market capitalization (SC) to GDP. *SV/GDP* is the stock market total value (SV) traded to GDP. *STR* is the stock market turnover ratio. *Herf* measures industry concentration. *Covar* is the first order autocovariance of market returns.

Country	*ES1*	*ES2*	*InvSoph*	*RSq*	*SC/GDP*	*SV/GDP*	*STR*	*Herf*	*Covar*
Australia	0.656	-0.823	41.28	0.069	0.934	0.656	0.790	0.256	1.435
Belgium	0.586	-0.852	29.81	0.173	0.668	0.197	0.287	0.198	20.720
Canada	0.674	-0.797	47.67	0.072	0.980	0.722	0.738	0.151	5.767
Denmark	0.610	-0.884	31.13	0.084	0.565	0.480	0.830	0.236	57.635
Finland	0.559	-0.848	32.59	0.150	1.776	1.543	0.895	0.181	6.312
France	0.587	-0.885	25.95	0.076	0.913	0.867	1.012	0.131	19.254
Germany	0.571	-0.896	25.60	0.124	0.554	0.841	1.429	0.191	18.043
Greece	0.431	-0.980	20.03	0.213	0.737	0.353	0.452	0.346	2.939
Hong Kong	0.489	-0.873	18.69	0.166	3.032	1.262	0.420	0.303	367.683
India	0.528	-0.873	4.85	0.204	0.214	0.539	2.508	0.300	0.086
Ireland	0.676	-0.830	30.31	0.066	0.652	0.229	0.337	0.282	0.818
Italy	0.532	-0.953	12.75	0.203	0.529	0.516	1.062	0.345	0.991
Japan	0.600	-0.946	29.88	0.243	0.585	0.486	0.810	0.146	43.568
Korea (South)	0.404	-0.971	35.32	0.184	0.427	1.782	4.041	0.184	0.170
Malaysia	0.627	-0.922	16.37	0.508	1.325	0.240	0.181	0.143	1.082
Netherlands	0.527	-0.871	29.02	0.119	1.305	2.882	2.341	0.233	35.153
Norway	0.773	-0.759	31.41	0.130	0.354	0.330	0.961	0.281	8.449
Philippines	0.749	-0.810	24.20	0.167	0.529	0.046	0.092	0.282	4.344
Portugal	0.421	-0.963	15.38	0.079	0.421	0.270	0.625	0.308	0.116
South Africa	0.677	-0.895	6.36	0.216	1.405	0.640	0.469	0.489	0.206
Spain	0.551	-0.903	26.94	0.201	0.743	1.539	2.080	0.227	1.185
Sweden	0.685	-0.789	29.42	0.164	1.172	1.569	1.296	0.278	196.490
Switzerland	0.530	-0.925	34.82	0.166	2.382	1.239	0.551	0.350	78.277
U.K.	0.621	-0.858	33.06	0.074	1.468	1.369	0.939	0.151	11.590
U.S.	0.784	-0.759	40.66	0.025	1.247	3.103	2.506	0.151	17.424
Mean	0.594	-0.875	27.86	0.155	0.997	0.948	1.106	0.246	35.990
Std. Dev.	0.102	0.063	9.50	0.094	0.658	0.795	0.928	0.086	80.556
Correlation									
ES1	1.000								
ES2	0.911	1.000							
InvSoph	0.011	0.214	1.000						
RSq	-0.207	-0.424	-0.418	1.000					
SC/GDP	-0.100	0.116	-0.156	0.041	1.000				

SV/GDP	0.030	0.163	0.396	-0.298	0.439	1.000			
STR	-0.180	-0.159	0.307	-0.120	-0.267	0.690	1.000		
Herf	-0.148	-0.195	-0.412	0.065	0.094	-0.266	-0.236	1.000	
Covar	-0.173	0.053	-0.155	-0.011	0.793	0.203	-0.151	0.134	1.000

3.3 Investor Sophistication

The notion of investor sophistication or informedness is conceptually simple but empirically complex. How is it possible to know that an investor recognizes an information event or understands the ramifications of the event? In the case of earnings smoothing, the answer to this question is confounded by the difficulty of determining whether sophisticated investors demand less earnings smoothing by managers or managers smooth less to attract sophisticated investors. To mitigate this endogeneity issue, we use the country's percentage of population age 25+ with completed tertiary education, InvSoph, to proxy potential investor informedness.[6] Our source these data is the World Bank (2014) and individual country values are presented in Table 3. The values range from 4.85% for India to 47.67% for Canada, with a mean of 27.86%. As indicated earlier, we convert InvSoph to a binary variable DInvSoph, where DInvSoph equals one if InvSoph is greater than its mean and zero otherwise. In either form, our proxy relies on the assumption that a more educated population tends to be more informed than one that is less educated.

3.4 Control Variables

The success of trading strategies may be influenced by a number of market related factors. For instance, in a series of papers LaPorta et al. (1997, 1998, and 2000) argue that the financial behavior by firms and markets are strongly influenced by the legal system in which they operate. Many other researchers have contributed to this literature as well. Particularly relevant for our study is Allen & Gale's (1994) observation that opaque security rules and regulations may be a barrier to arbitrage and their suggestion that the way in which firms provide information is closely related to investor protection. In addition, from an empirical perspective, Morck, Yeung & Yu (2000) report that asset prices tend to move together in countries where investor protection is low, a finding confirmed and extended to opaqueness by Jin & Myers (2006). This comovement suggests that asset prices in low investor protection countries may not be as informative as they are in high investor protection counties. Moreover, to maintain a viable market, trading volume must be large enough to ensure sufficient market depth and corresponding liquidity to avoid excessive price volatility. In this regard, Lesmond, Schill & Zhou (2004) point out that indirect and direct transaction costs also may affect the profitability of trading strategies, and Elewarapu & Venkataraman (2006) report that trading costs are negatively related to judicial efficiency and political stability. Finally, some markets are dominated by few industries, potentially causing industry-related shocks to make stock prices move together more frequently than would be the case in lesser concentrated markets.

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[6] A typical approach is to use institutional ownership to proxy informedness (e.g., Hand, 1990; Walther, 1997; El-Gazzer, 1998; and Bartov, Radhakrishnan & Krinsky, 2000). We do not use this approach for two reasons. First, institutional ownership data are a noisy measure of investor sophistication as many institutions tend to be passive (index) investors. Second, there is little reliable international data on institutional ownership.

To hold these and other market-wide effects constant, we use the following control variables, the values of which are given in Table 3, along with their correlations and their correlations with ES1 and ES2: (1) asset price comovement (RSq), (2) ratio of stock market capitalization (SC) to GDP, (SC/GDP), (3) ratio of stock market total value traded (SV) to GDP, (SV/GDP), (4) stock market turnover ratio (STR), (5) industry concentration (Herf) as measured by the Herfindahl index constructed using market capitalization and (6) autocovariance of market returns (Covar). The potential importance of RSq is highlighted by noting that Morck, Yeung & Yu (2000) show that average of market model R^2s also reflects the other market characteristics mentioned above and is highly correlated with other measures of comovement.

4. Results of Hypothesis Tests

We report the results of our probit estimates for equation (1) using the 6/1/6 strategy in Table 4. Panel A provides the estimates associated with *ES1* while Panel B displays those of *ES2*. Both panels contain the regression results with and without the six control variables. We use a one-tailed t-test to test the null hypothesis that momentum profits in less sophisticated markets should not be lower than those in sophisticated markets for all levels of earnings smoothing. This relationship is captured by the earnings smoothing and investor sophistication interaction term. All of the other p-values reflect a two-tailed t-test.

According to the t-tests, in neither panel do the p-values of any of the control variables indicate that these variables provide explanation at conventional levels of statistical significance (the lowest is 0.330). Nevertheless, we focus on the regressions containing these variables because they increase the overall explanatory power of the regressions, suggesting that the statistical insignificance of their respective parameters may be the result of multicollinearity.[7] Moreover, the magnitudes of the smoothing and investor sophistication parameters are similar whether or not the control variables are included. As we did before, we are generous in the size of the Type II error probability that we allow. This is because our regressions have only 16 degrees of freedom.[8]

As shown in Table 4, in none of the models are the coefficients for earnings smoothing or investor sophistication by themselves significant at the 10% level. Nevertheless, the coefficient of the interaction term, β_3, is positive and statistically significant at least the 5.3% critical level regardless of whether *ES1* or *ES2* is used as our measure of earnings smoothing, thereby signaling the rejection of our null hypothesis (i.e., Ho: $\beta_3 \leq 0$). This rejection supports the notion that, in sophisticated (informed) markets an increase in earnings smoothing is associated with a decrease in the probability of statistical arbitrage. If, however, markets are not sophisticated (uninformed) the degree of earnings smoothing has no effect this probability. Stated differently, the probability of successfully using statistical arbitrage to exploit the presence of momentum depends on the amount of earnings smoothing where this dependency

[7] For example, the correlation between *Covar* and *SC/GDP* is 0.793 and between *SC/GDP* and *SV/GDP* is 0.439.

[8] Our strategy for extremely small sample sizes is opposite to the one often employed to account for the possibility of a very small Type II error in extremely large sample sizes. The latter requires that the critical t-statistic be larger than the conventional value to account for the Lindley Paradox. In our case, we believe that the critical t-statistic value should be smaller than conventionally accepted. Nevertheless, instead of t-statistics, we report p-values to permit the reader to make her own assessment as to the statistical significance of our findings. For a recent discussion concerning statistical significance and sample size, see Harvey & Liu (2014).

is driven by the level of investor sophistication.[9]

Table 4. Probit model: Momentum profits and investor sophistication

This table summarizes the results of the estimating equation (1) with and without the control variables:

$$P(MOM_{6/1/6} > 0) = \beta_0 + \beta_1 Smooth + \beta_2 DInvSoph + \beta_3 SmoothxDInvSoph + \sum_{i=4}^{9} \beta_i Control_i + e \cdot \text{(2)}$$

$P(MOM_{6/1/6}>0)$ is a binary variable that takes a value of one if there is statistical arbitrage in the momentum profits with 6-month ranking and investment periods and zero otherwise. *DInvSoph* is a binary variable that takes value of one if investor sophistication proxy is greater than the sample average and zero otherwise. The control variables are defined in Table 3. Panel A (B) reports the results based on *Smooth* being *ES1* (*ES2*). Robust p-values are provided below the estimated values, and the R^2s show the goodness of fit of the regressions. The p-values for the β_i's except β_3 are for a two-tailed hypothesis while the p-values for β_3 are for a one-tailed hypothesis test.

Panel A. Earnings smoothing (*Smooth*) measured by *ESI*

				Control variables						
Constant	*Smooth*	*DInvSoph*	*Smooth x DInvSoph*	*RSq*	*SC/GDP*	*SV/GDP*	*STR*	*Herf*	*Covar*	
β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	R^2
1.283	-4.755	-4.416	8.761							0.08
(0.580	(0.258)	(0.146)	(0.009)							
1.270	-4.623	-5.780	10.410	-2.174	0.640	-0.197	0.601	-0.298	-0.008	0.37
(0.730)	(0.392)	(0.164)	(0.025)	(0.663)	(0.596)	(0.859)	(0.451)	(0.903)	(0.270)	

Panel B. Earnings smoothing (*Smooth*) measured by *ES2*

				Control Variables						
Constant	*Smooth*	*DInvSoph*	*Smooth x DInvSoph*	*RSq*	*SC/GDP*	*SV/GDP*	*STR*	*Herf*	*Covar*	
β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	R^2
-18.478	-19.077	18.508	21.931							0.12
(0.160)	(0.139)	(0.179)	(0.053)							
-20.713	-20.597	20.695	24.469	-5.238	0.837	-0.309	0.596	-0.132	-0.008	0.59
(0.195)	(0.210)	(0.211)	(0.041)	(0.367)	(0.442)	(0.733)	(0.408)	(0.804)	(0.330)	

[9] The significance of β_3 is also consistent with the idea that, in markets that exhibit any level earnings smoothing, an increase in market sophistication is associated with a decrease in the probability of statistical arbitrage, although the impact is larger for markets with higher levels of smoothing. We do not think that this interpretation is valid because although it is plausible that the educational level of a country might provide an environment for a manager to attempt to smooth earnings, it seems farfetched that a country's educational level would be determined by the managers' collective ability or inclination to engage in this activity.

5. Concluding Remarks

We present evidence that interaction of investor sophistication and earnings smoothing creates varying influence on cross-sectional variation in expected returns. Following a consistent theme in the literature, we conjecture that liquidity investors want managers to smooth earnings as much as possible to minimize potential future losses from trading with informed investors. However, whether the market can comprehend the reasons for and the consequences of earnings smoothing depends on the level of market sophistication. In a naïve market, investors may not be able to understand the nature of smoothed earnings and, therefore, the possibility that managers cannot sustain earnings smoothing and reveal occasional large losses. This possibility should increase the cross-sectional variance of expected returns; hence, momentum profits should be more pronounced. Our results based on data from 25 countries confirmed this prediction.

We believe our results are provocative for two reasons. First, our results suggest that the price of earnings smoothing depends on investor sophistication. Under the classical asset pricing framework, the price of earnings smoothing is zero because investors are assumed to be sophisticated and able to diversify the idiosyncratic risk associated with earnings smoothing. In naïve markets, this may not be the case, thereby creating variation in expected returns. This means that the value-relevance of accounting numbers (smoothed earnings in our case) should not only be judged on their explanatory power on expected return (or price) but also on their impact on the cross-sectional variation when this variation cannot be diversified.

Second, the analysis of momentum profits using market specific factors sheds light on the relationship between earnings smoothing and investor sophistication. The answer to why managers smooth earnings is beyond the scope of this study but we do provide some clues for future research. If earnings smoothing is undertaken for opportunistic reasons, e.g., managers hide their worse performances by shifting income from prior periods, the incidence of earnings should be higher when managers are less likely to be punished for such actions as is the likely case in naïve markets. If, however, earnings smoothing is done to aid naïve investors by reducing volatility, earnings smoothing should be demanded more in naïve markets. In either case, earnings smoothing is related to investor sophistication and our results are consistent with both of these alternatives.

Appendix 1

In this appendix we summarize the methodology developed in Hogan et al. (2004) that tests the existence of statistical arbitrage for a particular zero investment trading strategy. Let $v(t_1)$, $v(t_2)$, . . . , $v(t_n)$ denote a time series of discounted cumulative trading profits that are generated by the strategy. Then let $\Delta v_i = v(t_i) - v(t_{i-1})$ represent its increments at equidistant time points $t_i - t_{i1} = \Delta$ with $t_i = i\Delta$ so that these incremental trading profits satisfy $\Delta v_i = \mu i^{\theta} + \sigma i^{\lambda} z_i$ for $i = 1,2,\ldots,n$, where z_i are i.i.d. $N(0,1)$ random variables.

In this case discounted cumulative trading profits generated are

$$v(t_n) = \sum_{i=1}^{n} \Delta v_i \approx N(\mu \sum_{i=1}^{n} i^{\theta}, \sigma^2 \sum_{i=1}^{n} i^{2\lambda}),$$

and the log likelihood function for the increments is

$$LogL(\mu, \sigma^2, \lambda, \theta | \Delta v) = -\frac{1}{2} \sum_{i=1}^{n} \log(\sigma^2 i^{2\lambda}) - \frac{1}{2\sigma^2} \sum_{i=1}^{n} \frac{1}{i^{2\lambda}} (\Delta v_i - \mu i^{\theta})^2 .$$

The parameters to be estimated are μ (momentum profits per period), θ (growth rate in momentum profits), σ^2 (volatility), and λ (growth rate in volatility). A trading strategy generates a statistical arbitrage with 1-α percent confidence if the following conditions are satisfied:

H1: $\mu > 0$

H2: $\lambda < 0$

H3: $\theta > \max(\lambda - ½, -1)$

Similar to Hogan et al. (2004), we use unconditional mean estimates, i.e., $\theta = 0$.

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