On the efficiency of capital markets in processing financial-reporting information: New evidence from earnings releases *

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Abstract

This study investigates the efficiency of capital markets in processing financial-reporting information as manifested during and after earnings releases. Unlike prior studies on post earnings announcement drifts (PEAD) which track price trends in relation to earnings news, we posit that investors should make use of a broader set of fundamental information for value discovery. Guided by the real-options based valuation framework (Zhang 2000; Chen and Zhang 2007), we examine the roles of five fundamental factors constituting "core" information: earnings, profitability (ROE), capital investment, growth opportunity, and the discount rate. Empirical results show that all five factors have power to explain both initial price reactions at earnings releases and subsequent price drifts. In post-announcement periods, price drifts extend the initial reactions with respect to four of the factors (earnings, profitability, growth opportunity, and the discount rate) but reverse the initial reactions with respect to capital investment, indicating that investors are prone to both under-reactions and over-reactions to different information. Further analysis shows that the previous earnings-based PEAD anomaly captures only a portion of gradual price adjustment to released information, and its existence actually depends on the nature of news conveyed by other (non-earnings) factors. From an investment perspective, hedge-portfolios formed on our five factors earn abnormal returns well above those based on earnings news alone. We conclude from the study that deviations from the efficient market paradigm are a *general* phenomenon displayed when investors seek to discover value based on fundamental information, thus calling into question the realism of this widely used theoretical benchmark.

Key Words: market efficiency, financial reporting, post-earnings announcement drift, efficiency market hypothesis

1. Introduction

Financial reporting that firms periodically perform bridges the real and financial sectors of an economy and provides vital information for market trading and ultimately resource allocation. How investors extract valuation-relevant information from financial reporting data and how efficiently they incorporate such information into stock prices are among the central questions in capital market research. According to Fama's (1970) Efficient Market Hypothesis (EMH), investors should respond to information arrivals in a timely and accurate manner, and prices should be quick to reflect information already made public. However, observed price behavior does not always conform to the scenario depicted by the EMH, notably regarding the processing of firms' earnings news. For example, it has been well documented that after public releases of earnings reports, stock prices undergo a prolonged period of adjustment to earnings news (Ball and Brown 1968; Bernard and Thomas 1989, 1990; Brennan 1991; Fama 1998), suggesting that investors are slow to grasp the implications of reported earnings. This phenomenon—known as the post earnings announcement drift (PEAD)—occurs in many countries around the world (e.g., Griffin, Kelly and Nardari 2010), and has been a recurring scene in the decades after the initial discoveries.

Prior PEAD research has been centered on a particular reported item (i.e., earnings). In academic research as well as in the investment industry, it is common to use earnings surprise (unexpected earnings) as a measure of "new" information, which seems intuitive in the context of an earnings event. However, from a conceptual standpoint, this approach is restrictive because firms disclose more than just earnings data. Financial reports that firms regularly issue contain multiple statements, and the different components of a report need to work together to portray the underlying business. Therefore, investors are expected to utilize a comprehensive set of financial data to discover value. Indeed, recent decades have increasingly witnessed firms' also disclosing non-earnings data at the time of earnings releases (such as balance-sheet information). The purpose of this study is to gain a more systematic view of how investors process financial reporting data when made public and how the process of price discovery unfolds over time.

We use the real options-based valuation models (Zhang 2000; Chen and Zhang 2007) as the theoretical foundation to pin down the specific fundamental variables of interest. These models are built on the ground that (a) firms generate value by undertaking profitable investment projects and (b) accounting information serves to guide investment decisions. The models yield distinctive predictions regarding how financial-statement data should be processed and how different financial statements should be combined to form the

informational basis for valuation. Within this framework, five factors emerge that constitute "core" information: four factors convey cash-flows—earnings, (equity) capital investment, profitability, and growth opportunity, whereas the fifth concerns the discount rate. As explained below, these factors each convey a particular dimension of the underlying operation, and together they form the "full" set of fundamental information for valuation (in the context of the original models).

Our empirical analysis first examines price behavior at the time of (quarterly) earnings releases. Consistent with the predictions of the theoretical models, we find that market reactions to earnings releases are positively related to changes in expected cash flows as conveyed by the four cash flow-related factors, and negatively related to changes in the discount-rate. And each of these variables has incremental power to explain immediate price reactions. This shows that all five factors identified in theory play a significant role in shaping investor beliefs about firm value.

We then explore stock price movement after earnings releases. As in previous PEAD studies, we find that prices continue to adjust to released information for weeks following announcements, generating predictable returns. As already shown in the literature, during post-announcement periods, prices move in directions that extend the initial reactions to news about earnings. Importantly, we find that post-announcement price drifts also extend the initial reactions to news about profitability, growth opportunity, and the discount rate, indicating a more wide-spread underreaction phenomenon. Yet, that is still not the whole story, and we find that price drifts actually reverse the initial reactions to news about capital investment. Thus, investors seem to be prone to both under-reaction and over-reaction, depending on the specific aspects of operational information being processed.

Regarding the "completeness" of initial reactions, we find that the magnitude of price changes over the three-day announcement window is comparable to the amount of price drifting over the post-announcement window with respect to news about earnings, profitability, and growth opportunity; this indicates that over the announcement window, prices absorb about half of the total information content conveyed by these three factors. On the other hand, initial reactions to news about capital-investment and discount-rate factors are small relative to the respective post-announcement drifts, possibly because investors face more challenges in deciphering information concerning these two factors.

Next, we conduct several tests to distinguish post-announcement price behavior uncovered in this study, which relates to a broader set of financial-reporting information, from earnings-based PEAD. First, we run regressions of abnormal returns over the post-

announcement window on our fundamental factors after controlling for earnings news, and find that the non-earnings factors all have incremental power to explain price drifting. Second, importantly, we discover that earnings-based price drifting is not a universal phenomenon; rather, its existence depends on signals from the non-earnings factors. For example, while on average firms with positive earnings news experience an upward price drift, such a trend is not present when the non-earnings factors send out unfavorable news. Likewise, firms with negative earnings news do not experience a downward price drift when the other factors convey favorable news. Third, investment strategies based on our fundamental factors earn abnormal returns that are well above those based on earnings news alone. A hedge portfolio designed using all five factors generates an average (size adjusted) abnormal returns of 5.70% per quarter (22.80% annualized) over the period of 1990-2013, with positive abnormal returns in all 24 sample years. In contrast, a similarly constructed portfolio based on earnings news earns an average abnormal return of 3.22% per quarter (12.88% annualized), and it is outperformed by our strategy in 21 of the 24 years. Together, our results indicate that the earnings-related PEAD anomaly shown in the literature captures only one aspect of general price behavior displayed when investors revise beliefs upon releases of financial reporting data.

Our study sheds light on how efficiently capital markets incorporate fundamental information into stock prices. Conventionally, researchers use Fama's EMH as the benchmark to gauge the informational efficiency of prices. Under the EMH, investors are expected to respond to publicly released information in a timely manner and be quick to incorporate new information into prices, without lengthy delays. However, empirical evidence surrounding the event of earnings releases from this study, as well as from prior research, is markedly different. While it is indeed the case that investors are quick to *react* to released information, they require a considerable amount of time to digest information and reach a new equilibrium. As this study shows, initial price reactions typically are far from complete and, in some cases, are in wrong directions. More importantly, our evidence indicates that in processing financial reporting information—the most essential source of information for sustaining markets' operations, deviation of price behavior from the EMH exists as a systematic phenomenon, i.e., a market norm, rather than an aberration; indeed, it occurs with respect to *all* elements of core fundamental information identified in theory, and is not isolated to particular reported items (e.g., earnings). Our findings call for fundamental rethinking of how relevant the EMH is in serving as a theoretical benchmark, at least in the context of markets' processing of fundamental information.

To gain a perspective on why the EMH might not effectively characterize actual price

behavior, note that in the EMH framework, information is treated in an abstract notion without specific content. For example, typically, information is modeled as a signal of (i.e., proxy for) cash flow and value. In this abstract context, the price impact of a given piece of information is apparent, and investors should need little time to adjust price. However, in reality, information that investors receive from firms is transaction-level data; while essential for valuation, transaction-level data are not synonymous to firm value and cannot be realistically viewed as value proxies. Indeed, a key task of investors is to map transaction-level data to firm value, and this requires sophisticated skills and is time consuming. In an attempt to rationalize anomalous price behavior including the slowness of the price adjustment process, the extant literature often resorts to behavioral factors (limited ability and attention) and market frictions. In contrast, valuation theory suggests that there can be economic-based factors at work as well. For example, according to real options based models, earnings information needs to be combined with other information (including information beyond financial reporting) to revise expectations about firms' future operations (for example, growth options). If so, investors need to search for complementary information or wait for further events to unfold, in order to properly interpret earnings data, which can take much time. Thus, instead of simply comparing observed price dynamics to the EMH, it would be fruitful to look into the specific tasks carried out by market participants who seek to convert received raw data into a final valuation outcome, such as what additional information investors need to collect and what assumptions and judgment they have to make.[1]

Our study extends a long line of research examining PEAD behavior. First, it shows that in post-announcement periods, stock prices adjust to a more comprehensive set of financial reporting information than earnings news alone. While earnings performance is vital information, investors also need information to update beliefs about the scale (capital investment and growth) and efficiency (ROE) of future operations, and also to revise firm risk (the discount rate).[2] We observe that post-announcement price drifting occurs along all these dimensions as well as earnings news. Second, while prior studies attribute the PEAD anomaly

[1] This is the topic addressed in accounting-based valuation research (Ohlson 1995; Zhang 2000); see Zhang (2014) for a synthesis of the theoretical and empirical literature. In developing our study, we make use of the theoretical results from this literature.

[2] Several studies extend the PEAD literature by looking into the attributes or components of earnings such as the level of reported earnings (Balakrishnan, Bartov and Faurel 2010), the accrual component of earnings (Collins and Hribar 2000), and revenue surprises (Jegadeesh and Livnat 2006). Other studies link the PEAD phenomenon to market-level characteristics such as return momentum (Chan et al. 1996; Chordia and Shivakumar 2006) and trading volume (Lerman, Livnat and Mendenhall 2008). However, these studies lack an underlying theory to motivate their extended investigations.

to investors' under-reaction earnings news (Bernard and Thomas 1989, Fama 1998), we find that there also exists investor over-reaction to certain information (e.g., capital investment). The study provides a more systematic view of how investors extract valuation-relevant information from reported financial data and how efficiently they incorporate such information into prices.[3]

Finally, our study also contributes to the general literature on market anomalies. Numerous studies have documented patterns of predictable returns (anomalies) that are correlated with firm-level attributes (size, book-to-market, price-to-earnings, profitability, capital investment) and market characteristics (momentum). In general, these discoveries are empirical in nature and have little theoretical guidance (Hou, Xue and Zhang, 2017). In justifying the anomalies, researchers have resorted to market-level factors (e.g., transaction cost, liquidity, and information uncertainty) or behavioral factors (e.g., investor naivety and limited attention). But these explanations are largely detached from firms' economic activities—the source of value generation, and there lacks an economic-based story to explicate why and how the particular variables associated with return anomalies should indeed matter. Our study takes a different approach. We use valuation models to identify specific fundamental variables that portray value-generating activities, and so there is a clear economic-based reason for why, and how, investors need to understand firm value through these constructs. Previously, Hwang and Sohn (2010) and Rao, Yue and Zhou (2018) also employ real-options based models to uncover patterns of return predictability, but they both focus on a particular information item, not a whole information set supporting valuation, and they do not address the PEAD literature.

The rest of the paper proceeds as follows. Section 2 discusses the related literature and presents our research questions. Section 3 describes variable construction and the sample. Section 4 discusses the empirical results. In section 5 we perform robustness checks of our results, and we conclude in section 6.

2. Literature Review and Research Questions

2.1 Market efficiency and anomalies

Conventionally, the informational efficiency of capital markets is gauged in terms of the speed and accuracy with which new information is reflected in stock prices (e.g. Fama 1970,

[3] Our study based on the earnings reporting event complements existing valuation research demonstrating the role of accounting variables in explaining contemporaneous stock prices and returns (Chen and Zhang 2007; Hao, Jin and Zhang 2011).

1991). Rational investors are expected to respond to information conveying firm value in a timely manner (Fama, Fisher, Jensen and Roll 1969; Fama 1970), and in an efficient market (of semi-strong form), all publicly available information is incorporated into stock prices quickly and accurately such that investors earn only a normal risk-adjusted return (Malkiel 2003). Against this theoretical benchmark, however, numerous studies have documented market behavior that is distinctly different, with predictable returns in the cross section, referred to as anomalies (Fama and French 2008). Anomalies challenge the validity of the efficient market paradigm, as they seem to present profitable trading opportunities.

In the existing literature, patterns of predictable returns have been related to firm characteristics such as market capitalization (Banz 1981) and the book-to-market ratio of equity (Rosenberg, Reid, and Lanstein 1985; Chan, Hamao, and Lakonishok 1991); stock return momentum (Jegadeesh and Titman 1993); firm performance such as profitability (Haugen and Baker 1996; Cohen, Gompers, and Vuolteenaho 2002) and innovative efficiency (Hirshleifer, Hsu and Li 2013); capital investment (Fairfield, Whisenant, and Yohn 2003; Titman, Wei, and Xie 2004); financing activities such as net stock issues (Daniel and Titman 2006; Pontiff and Woodgate 2008); and macroeconomic information (Li, Richardson and Tuna 2014). Other studies have linked predictable return patterns to specific accounting items such as earnings (Ball and Brown 1968); accruals (Sloan 1996; Xie 2001); special items (Burgstahler, Jiambalvo and Shevlin 2002); and net operating assets (Hirshleifer, Hou, Teoh and Zhang 2004).

In search for reasons why investors fail to adjust prices to known information (or charactersitics) on a timely basis, researchers have considered market-level factors such as transactions cost, market liquidity, and information uncertainty, as well as behavioral factors such as investor naivety and limited attention. Some also question the adequacy of the established asset-pricing theories such as the capital asset pricing model as the benchmark (e.g., Fama 1970). While these factors can conceivably influence the degree of market efficiency, they pertain to characteristics of market settings and market participants that affect trading decisions, but have little to say about firms' economic activities which ultimately are the source of value generation.

2.2 PEAD as a delayed response to earnings news

Ball and Brown (1968) first note that in the months subsequent to annual earnings announcements, stock prices experience an upward drift for firms that have reported favorable earnings news and a downward drift for firms that have reported unfavorable earnings news. This phenomenon is subsequently reaffirmed by a stream of studies using U.S.

data covering various time periods (e.g., Joy, Litzenberger and McEnally 1977; Watts 1978; Rendleman, Jones, and Latane 1982; Foster, Olsen and Shevlin 1984; Bernard and Thomas 1989). The reported amount of price drifts ranges between 4.2% and 6.3% per quarter (e.g., Foster, Olsen and Shevlin 1984; Bernard and Thomas 1989; Abarbanell and Bernard 1992; Livnat and Mendenhall 2006; Lerman, Livnat and Mendenhall 2007; Ng, Rusticus and Verdi 2008), which is economically, as well as statistically, significant.

The PEAD anomaly is also discovered in other markets such as the United Kingdom, Spain, New Zealand, and Greece (Hew, Skerratt, Strong and Walker 1996; Forner and Sanabria 2010; Truong 2010; Forbes and Giannopoulos 2015). According to Griffin, Kelly, and Nardari (2010), PEAD is prevalent around the world; it is found in 16 of the 25 developed markets and in 12 of the 14 emerging markets in their study. PEAD is such an incredibly robust phenomenon that the evidence is "above suspicion" (Fama 1998). The phenomenon has been documented by more than four decades of academic research (Taylor, 2011).

The PEAD anomaly is interpreted as investors' underreaction, or delayed response, to earnings news (e.g. Bernard and Thomas 1989, 1990; Ball and Bartov 1996; Livnat and Mendenhall 2006; Shivakumar 2006). Fama (1998, p. 286) calls PEAD "the granddaddy of all under-reaction events", and it is considered one of the most robust anomalies that challenge the efficient market paradigm (e.g. Bernard and Thomas 1989, 1990; Brennan 1991; Fama 1998; Chordia and Shivakumar, 2006; Hung, Li and Wang, 2014). As in the general anomalies literature, existing studies attribute PEAD to (i) behavioral factors such as investors' misunderstanding of earnings properties (e.g. Narayanamoorthy 2006; Cao and Narayanamoorthy 2012), naive investor behavior (e.g. Bartov, Radhakrishnan and Krinsky 2000; Vega 2006), and limited attention (e.g. DellaVigna and Pollet 2009; Hirshleifer, Lim, and Teoh 2009); and (ii) market frictions such as the cost of arbitrage (e.g. Bhushan 1994; Mendenhall 2004), and information uncertainty (Francis, Lafond, Olsson and Schipper 2007; Hung, Li and Wang 2015).[4]

A limitation of existing PEAD research is its exclusive focus on earnings news. In practice, investors are expected to utilize a broad set of financial information that firms disclose, not just earnings. The questions are: which information variables, in addition to earnings, should be considered? And how efficiently do stock prices adjust to news conveyed by these other variables? In particular, can we expect to see a similar (or different) type of price drifting with respect to other (non-earnings) information?

In this study, instead of launching an exercise of data-mining, we rely on the guidance of

[4] Also see the Taylor (2011) for a review of existing explanations for the PEAD anomaly.

theoretical models to identify core information for valuation, which we introduce below.[5]

2.3 Accounting variables and equity value: the theoretical foundation

We start with the real-options based model of Zhang (2000), which determines the cross-section of equity value that is explained by financial reporting variables. This model is built on the basic premise that firms generate value by directing capital resource into profitable investment opportunities (and withdraw resource out of unprofitable opportunities) and that accounting signals provide essential guidance to investment decisions (Biddle, Chen and Zhang 2001). In this context, firm value is characterized as the value from existing operations plus the real options to grow and/or contract the scale and scope of operations. While the notion that firm value comprises existing assets and growth opportunities has long been recognized in the finance literature, the model of Zhang (2000) explicitly expresses firm value in terms of observable information generated from the firm's accounting system (together with information from other sources).[6]

Following the exposition in Zhang (2014, Ch. 9), we express Zhang's real-options based model (ROM) as:

$$V_t = B_t[P(ROE_t) + \frac{ROE_t}{r_t} + g_t C(ROE_t)], \qquad (1)$$

where B_t is the firm's book value at date t (the end of period t); ROE_t is the return on equity earned in period t; g_t is the investment growth opportunity as at date t; and r_t is the discount rate as at date t; $P(ROE_t)$ is the value of the option to abandon the operation in the future, which resembles a put option; $g_t C(ROE_t)$ is the value of the option to grow the investment scale. This model shows that in determining firm value, investors seek to understand the firm's operation through two attributes: the scale of capital resource contributed by investors as measured by equity book value (*B*), and the efficiency with which the firm generates value from invested capital as measured by profitability (*ROE*). Information pertaining to these variables is directly conveyed by the firm's financial report. In addition, investors need to assess the firm's growth opportunities (*g*) and risk – which determines the discount rate (r). The latter variables typically require information from outside the financial

[5] An economically meaningful story is important because many accounting items are correlated with one another, so finding price drifting that is correlated with a particular accounting item does not necessarily mean that investors are interested in that information item per se.

[6] Empirical evidence is consistent with the predictions of the model (e.g., Chen and Zhang 2007; Hao, Jin and Zhang 2011). Other models of equity value include those by Ohlson (1995) and Feltham and Ohlson (1995, 1996), which characterize a firm's value generation by a linear stochastic process but without recognizing the role of accounting information in guiding firms' investment decisions.

report as well. The model also indicates that the information variables need to be used interactively in determining firm value.

Since our study explores how information released through an earnings announcement impacts stock prices, it is more direct to use a model of equity returns, which derives from changes in value. By taking changes of the model in equation (1), applying the definition that returns arise from capital gains an dividends, and invoking the basic accounting relation of clean surplus ($B_t = B_{t-1} + X_t - d_t$; that is, the book value at date t is equal to book value at date t-1 plus earnings minus net dividends in period t), we get a return model (see Chen and Zhang 2007; Zhang 2014):

$$R_t = \frac{X_t}{V_{t-1}} + v_1\left[\frac{B_{t-1}}{V_{t-1}}\right]\Delta ROE_t + \left(1 - \frac{B_{t-1}}{V_{t-1}}\right)\frac{\Delta B_t}{B_{t-1}} + C(ROE_t)\left[\frac{B_{t-1}}{V_{t-1}}\right]\Delta g_t + v_3\left[\frac{B_{t-1}}{V_{t-1}}\right]\Delta r_t, \qquad (2)$$

where $v \equiv P(ROE_t) + \frac{ROE_t}{r_t} + g_t C(ROE_t)$ and its partial derivatives are $v_1 \equiv dv/dROE_t$ and $v_3 \equiv dv/dr_t$. Also note $dv/dg_t = C(ROE_t)$.

According to Equation (2), equity return is related to five fundamental factors: earnings generated over the contemporaneous period, the profitability change over the period, the equity capital investment undertaken, the change in growth opportunity, and the change in the discount rate. In the discounted cash-flow framework, the first four factors relate to cash flows, whereas the fifth to the discount rate.

As explained in Chen and Zhang (2007) and Zhang (2014), the five variables each serve distinctive roles in conveying value changes. Specifically, current earnings represent value actually generated for the reporting period; the change in profitability revises expectations about the firm's efficiency in generating value from invested capital; capital investment affects the scale of operations, and so does the change in growth opportunity which affects future scale through anticipated investment; and, finally, the change in the discount rate complements the above cash flow factors to make the information set complete. Note that the first three variables are directly derived from financial reporting data, whereas growth opportunities and the discount rate typically require information from outside financial statements as well.

In essence, investors seek to understand a firm's value generation primarily along two dimensions of its operation: scale (size) and profitability (efficiency), as measured by book value (B_t) and profitability (ROE_t), respectively. Furthermore, financial reporting data need to be supplemented with information from other sources to determine the equity return over a period.

Immediate price changes are expected at earnings releases if investors are quick to react to information reporting (though the initial reactions might not fully capture the impact). Based on Chen and Zhang's (2007) model, we predict that market reactions at earnings announcements are positively related to (unexpected) increases in earnings, in profitability, and in growth opportunity, and are negatively related to increases in the discount rate. Furthermore, to the extent that capital investment creates (rather than destroys) value for investors (which implies that its coefficient in equation (2) is positive, $1 - \frac{B_{t-1}}{V_{t-1}} > 0$), we predict that immediate price responses are also positively related to capital investment.

The valuation models, however, do not speak to whether initial market reactions are complete and how prices continue to adjust to information afterwards. These are open questions to be addressed empirically in the study.

2.4 Research questions

Based on the above discussion, we now state our research questions:[7]

Research question 1. How do stock prices react to the five fundamental factors at the time of earnings announcements?

Research question 2. How do stock prices further adjust to the five fundamental factors after earnings announcements?

Research question 3. Are stock price drifts in relation to the five fundamental factors subsumed by the previous earnings-based PEAD anomaly?

3. Research Design and the Sample

3.1 Measures of fundamental variables

The five fundamental factors considered in the study are: earnings (*E*), equity capital investment as measured by book value (*B*), profitability (*q*), growth opportunity (*g*), and the discount rate (*r*). Because investors should only react to new information released from an event, we thus separate the unexpected part of a variable from the expected part. Most PEAD studies use a rolling seasonal random walk model for time-series forecasting (e.g. Foster, Olsen

[7] Since this study primarily focuses on the process of price adjustment following earnings releases and the real options based model has no predictions in this regard, we only state our research questions rather than hypotheses.

and Shevlin 1984; Bernard and Thomas 1990). Following this approach, we measure the expected value of a variable for a given quarter by the realized value in the same quarter last year.[8] Then, the surprise part of a variable, i.e., the news, is proxied by the difference between its realized value in quarter t and that in quarter t-4.

Specifically, we compute the surprise part of our fundamental factors as follows:[9]

$$ue_{jt} = \frac{E_{jt} - E_{jt-4}}{Shares_{jt}};$$

$$ub_{jt} = \frac{B_{jt} - B_{jt-4}}{B_{jt-4}};$$

$$uq_{jt} = q_{jt} - q_{jt-4};$$

$$ug_{jt} = g_{jt} - g_{jt-4};$$

$$ur_{jt} = \frac{XINT_{jt} - XINT_{jt-4}}{XINT_{jt-4}};$$

where ue_{jt} is the earnings surprise of firm j in quarter t, calculated from income before extraordinary items (E_{jt}) and the number of common shares outstanding at the beginning of quarter t ($Shares_{jt}$); ub_{jt} is the proportional change in the equity capital investment, with B_{jt} defined as the book value of equity; uq_{jt} is the profitability surprise, with q_{jt} (profitability) defined as the return on equity book value at the beginning of quarter t; ug_{jt} is the growth surprise, with g_{jt} defined as sales growth (($Sales_{jt} - Sales_{jt-4}$)/$Sales_{jt-4}$); ur_{jt} is the discount rate surprise, defined as the proportional change in interest and related expense ($XINT_{jt}$)—which is also derived from financial reporting data. For convenience, we also use the generic variable, *UFactor*, to refer to the surprise element of a fundamental factor in general.

Our variables require data from both the income statement and the balance sheet. We construct our initial sample from Compustat Preliminary History Dataset which contains accounting data that firms disclose at earnings press releases.[10] For a firm-quarter observation to be included, we require data availability at a quarterly earnings announcement for computing at least one of the five variables. The accounting data for the same quarter in

[8] Foster, Olsen, and Shevlin (1984) find the seasonal random walk model performs as well as more complex time-series models in predicting drift based on the earnings surprise.

[9] Existing PEAD studies typically scale unexpected earnings by the beginning price. Because that variable would be similar to one of the other factors (the profitability change) in the study, we use unscaled unexpected earnings instead to proxy for earnings news. Our results are similar based on the two alternative proxies.

[10] Hsu et al. (2016) confirm the reliability of Compustat Preliminary History Dataset in terms of balance sheet data disclosure by checking such data against earnings press releases retrieved from Factiva and Google for a randomly selected sample of firms.

the previous year (i.e., quarter t-4) are from the Compustat Fundamentals Quarterly database.

Following the common approach in PEAD studies, we separately rank firms in a quarter into decile groups on each of the fundamental factors (*UFactor*) and use the decile rankings of the variables in regressions (instead of their actual values); the variables so transformed are denoted as *Decile_ue*, *Decile_uq*, *Decile_ub*, *Decile_ug*, and *Decile_ur*. This approach helps to mitigate the effect of outliers and nonlinearities in return relations (see, e.g., Bernard and Thomas 1990; Bhushan 1994; Bartov, Radhakrishnan, and Krinsky 2000). Further, we follow Livnat and Mendenhall (2006) to transform the decile rankings in a way such that these measures have a value ranged from -0.5 to +0.5, with a median of 0. By doing so, the slope coefficient in regressions of abnormal returns on *Decile_UFactor* can be interpreted as the abnormal return earned on the hedge portfolio that takes a long position in firms in the highest *UFactor* decile and a short positon in firms in the lowest (negative) *UFactor* decile. In order to avoid a look-ahead bias in ranking firms in quarter t, we use the breakpoints determined in quarter t−1 instead (e.g., Bernard and Thomas 1989; Collins and Hribar 2000; Doyle, Lundholm and Soliman 2006).[11]

While price drifting in relation to earnings news is well established in the literature, our purpose is to explore whether there are also price drifts in relation to news conveyed by the other fundamental variables: profitability, capital investment, growth opportunities and the discount rate. We also aim to distinguish these drifts from earnings-based drifts and compare their economic magnitudes.

Because prior PEAD research uses standardized unexpected earnings (SUE) to measure earnings news, which is unexpected earnings scaled by the beginning market value, $Sue_{jt} = \frac{E_{jt}-E_{jt-4}}{Shares_{jt}}/P_{t-1}$, we thus also construct Sue as a control variable.

3.2 Cumulative abnormal returns

Size-adjusted returns are commonly used in prior research on earnings-related anomalies to measure abnormal returns, also known as excess returns; see, for example, Bernard and Thomas, 1990; Ball and Bartov,1996; Sloan, 1996; Dechow et al.,2008; Balakrishnan, Bartov and Faurel 2010; Zhang, 2012). Following this practice, we calculate daily abnormal returns on

[11] A look-ahead bias is introduced if we assign firm j into a decile group in quarter t when necessary data for some of the sample firms are still not available in the quarter, and hence classification cannot actually be performed. Nonetheless, Bernard and Thomas (1990) show that in examining the PEAD behavior, results are insensitive to whether one uses the current quarter's breakpoints or the prior quarter's.

a firm as raw returns minus the composite benchmark returns on the index of CRSP firms in the same size-decile and same stock exchange (NYSE/AMEX or NASDAQ) as the firm concern. We treat delisted firms in the same way as Shumway and Warther (1999) and Zhang (2012): that is, when a firm is delisted for poor performance (delisting code 500, or 520 through to 584), the delisting return is assumed to be -35 percent for a firm traded on the NYSE/AMEX, and -55 percent for a firm traded on the NASDAQ.

We use the sum of the daily size-adjusted returns over the 3-day announcement window to proxy for the immediate market reaction at the earnings announcement, and the sum over the post-announcement window to proxy for the price drift subsequent to the announcement. As in most PEAD studies (e.g. Livnat and Mendenhall 2006; Zhang 2012), our announcement window consists of the three days from the day preceding the Compustat announcement date, the announcement date, and the following day. And the post announcement window is defined as the period from two days after the earnings announcement to one day after the next quarter's earnings announcement.[12]

3.3 Sample selection

We begin our sample selection by retrieving all firm-quarters in Compustat in the period 1990-2013.[13] Following most PEAD studies, we adopt the following selection criteria to include firm-quarter observations (also see Appendix A):

a) At least one of the five *UFactor* variables can be calculated for a firm-quarter using data from the Compustat Preliminary History dataset.
b) The earnings announcement date is reported in Compustat.
c) An earnings report date is shown both in Compustat and in I/B/E/S, and the report dates in the two sources differ by no more than one calendar day. The report dates are not later than the next quarter's report date, and it is within 60 calendar days before or after the quarter end.
d) The firm can be linked to stock return data in CRSP database, and the firm's shares are traded on the New York Stock Exchange, American Stock Exchange, or NASDAQ.

[12] To avoid problems due to mistakenly recorded reporting dates, we define the post announcement window as one month if it is shorter than one month. And we end the post announcement period at the 74th trading days after the announcement if it contains more than 73 trading days (roughly 15 weeks from the announcement day).

[13] Recent PEAD studies also use samples with a similar start year. For example, Collins and Hribar (2000), Doyle, Lundholm and Soliman (2006) and Ng, Rusticus and Verdi (2008) all start their samples at year 1988.

e) Daily returns data are available in CRSP to calculate cumulative abnormal returns.

f) The market value of equity as at the beginning of the quarter is available from Compustat and is greater than $5 million, and the book value of equity at the beginning of the quarter is positive. This eliminates very small-cap firms with low liquidity, firms at their initial stages of operations, and firms close to liquidation.

g) There are no missing data for computing the explanatory and control variables in our regressions.

In regression analyses, we follow Hung, Li and Wang (2015) to control for firm-level attributes including size (*SIZE*), market-to-book ratio (*MTB*), beta (*Beta*), and return momentum (*PRERET*). Appendix B describes our variable definitions. All the continuous variables in the regressions are winsorized at the top and bottom 1% of the distributions (Griffin, Kelly, and Nardari 2010; Amihud et al. 2013).

Table 1 provides the summary statistics of the variables. As shown in panel A of Table 1, the mean cumulative abnormal return at the announcement window, *CAR*[-1,+1], is small and positive, consistent with previous studies (e.g., Penman 1984). The cumulative abnormal return for the post announcement window (*POSTCAR*) also has a positive mean. The means and medians of the decile rankings of the five fundamental variables are close to zero; they are not exactly zero due to the use of the prior quarter's cutoff points in assigning firms into decile groups. The mean and median unexpected earnings (*ue*) are close to zero, which are consistent with most PEAD studies. Finally, the summary statistics of our control variables are similar to those in previous studies (e.g., Hung, Li and Wang 2015).

[Insert Table 1]

Panel B of Table 1 provides the correlation matrix. The abnormal return over the announcement window, *CAR*[-1,+1], is positively correlated with news in the four cash flow factors (*decile_ue*, *decile_ub*, *decile_uq*, *decile_ug*), and is negatively correlated with news in the discount rate (*decile_ur*). This is consistent with the theoretical predictions of Chen and Zhang's (2007) model. The correlation coefficients are below 0.36, except for the correlations among unexpected earnings (*ue*), its decile ranking (*decile_ue*) and the decile ranking of unexpected profitability (*decile_uq*). High correlations are expected among these earnings and profitability variables due to the very similar economic meanings they convey. We do not include pairs of these highly correlated variables in the same regressions in order to avoid multicollinearity.

4. Main Results

4.1 Immediate market reactions at earnings announcements

We first examine stock price reactions at earnings announcements, as measured by *CAR[-1,1]*. If investors pay attention to released information in accordance with the return model of Chen and Zhang (2007), we expect that stock prices adjust to the surprise elements in the five fundamental factors. Table 2, Panel A, reports the results of regressing *CAR[-1,1]* on the decile rankings of the five variables. In columns (1) through (5) where the fundamental factors are used individually in regressions, the coefficient is positive on *Decile_ue*, *Decile_ub*, *Decile_uq*, and *Decile_ug*, and is negative on *Decile_ur*, all significant at the 0.01 level. That is, the abnormal market return at the earnings announcement increases with the unexpected changes in earnings, capital investment, profitability and growth opportunity, and decreases with the unexpected change in the discount rate (cost of capital). These results are consistent with the predictions of Chen and Zhang (2007), confirming that all five fundamental factors play a significant role in driving stock price changes at the time of financial data releases.

[Insert Table 2]

Next, we evaluate the completeness of initial market reactions by examining price movement in the aftermath of information releases.

4.2 Price drifting subsequent to earnings announcements

4.2.1 Regression analysis

The PEAD literature shows that stock prices continue to be swayed by earnings news after an earnings announcement, suggesting that prices incorporate earnings information in a slow and gradual fashion. Here, we explore whether price drifts exist with respect to the whole set of fundamental factors identified in theory.

Table 2, Panel B, shows the results of regressing the cumulative abnormal returns over our post-announcement period, *POSTCAR*, on the decile rankings of the fundamental factors. In row (1), we regresses *POSTCAR* on unexpected earnings (*Decile_ue*), and find that the coefficient on *Decile_ue* is positive and highly significant. This means that on average prices drift upward in the post-announcement period when reported earnings convey positive news, and drift downward when reported earnings convey negative news, confirming the well-established result in the PEAD literature. The slope coefficient is 0.0411 for the overall sample, which also equals the abnormal return per quarter on the hedge portfolio formed with the two extreme deciles of unexpected earnings (*Decile_ue*).

Untabulated results show that the coefficient on *Decile_ue* is significantly positive for the subperiods of our sample. This coefficient is 4.70% for period 1990-2001, and 3.47% for period

2002-2013, both significant at the 0.01 level. The smaller coefficient in the later period is also consistent with the view that increased arbitrage activity in more recent years reduces the abnormal returns that can be earned from the PEAD anomaly (e.g., Richardson, Tuna, and Wysocki 2010; Chordia, Subrahmanyam, and Tong 2014; Milian 2015).

In rows (2) through (5), we use the other fundamental factors to explain *POSTCAR* on an individual basis. The coefficients on *Decile_ub*, *Decile_uq*, *Decile_ug* and *Decile_ur* are all significant at the 0.01 level, indicating that price drifting during the post-announcement period is also present in relation to the other four factors.

The coefficients on *Decile_uq* and *Decile_ug* are positive in explaining *POSTCAR*, and that on *Decile_ur* is negative. These coefficient signs are the same as those in the initial market reactions shown in Panel A. This suggests that the market initially underreacts to news about profitability, growth opportunities, and the discount rate (as well as to news about earnings) at the time of an announcement event. The magnitude of the coefficients on *Decile_ue*, *Decile_uq* and *Decile_ug* in the drift tests in Panel B are comparable to those in the initial reaction test (Panel A), indicating that roughly half the information content about earnings, profitability, and growth opportunity is incorporated into prices over the announcement window. On the other hand, the coefficient on *Decile_ur* in panel B table 2 (-1.81%) is much larger in absolute magnitude than it is in panel A (-0.15%), which means that most of the information about risk changes (as proxied by *ur*) is not captured by the market immediately.

In contrast to the above situations of under-reaction, the negative coefficient we find on *Decile_ub* in explaining *POSTCAR* is in opposite direction to the initial positive market reaction at announcement. This suggests that investors initially overreact to news about capital investment and subsequently have to reverse the previous changes. The magnitude of the coefficient on *Decile_ub* in explaining *POSTCAR* (-1.44%) is larger than that in explaining *CAR[-1,1]* (0.55%). One reason could be that a firm's capital investment activities take place throughout the reporting period, and much of the information conveyed by this variable may have already been disclosed prior to the earnings report (through, for example, announcements of mergers or divestitures), and so investors may have already reacted to such information prior to the earnings announcement. If so, what the market reaction at the earnings announcement captures could be only a fraction of the total price adjustment made up to that point (which is later reversed in the post-announcement period).[14]

Overall, our evidence shows that the initial market reaction at the earnings

[14] Chen and Zhang (2007) find that stock returns are positively related to capital investment in the contemporaneous period.

announcement is either incomplete or in the wrong direction with respect to all of the fundamental factors constituting core information. Thus, it appears to be a general phenomenon that investors are unable to correctly and fully grasp the valuation implications of fundamental information with a relatively short period of time (say, several days), and information is reflected into prices only gradually, contrary to the EMH of Fama (1970).

4.2.2 Hedge portfolio returns

We now construct hedge portfolios that exploit the particular price behavior in the post earnings announcement period. Our strategy makes use of information conveyed by all five fundamental factors. We separately rank firms in a quarter on the five factors to determine their quintile rankings (i.e., from 1 to 5) of the factors, and then for each firm, we combine the rankings across the factors to determine a composite score, denoted as *Score5F*. Again, we use the breakpoints of the previous quarter in performing quintile rankings to avoid look-ahead biases. We use the following formula to compute *Score5F* that takes into consideration the directions of price drifting with respect to the individual factors:

Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur

The highest value of *Score5F* for a firm-quarter is 13, which occurs when the observation is simultaneously in the highest quintile for *ue*, *uq* and *ug* and in the lowest quintile for *ub* and *ur*. The lowest value is -7, which occurs when the observation is simultaneously in the lowest quintile for *ue*, *uq* and *ug* and in the highest quintile for *ub* and *ur*. The hedge portfolio is constructed using those observations with no missing data for computing *Score5F*.[15]

[Insert Table 3]

Table 3 presents the mean of (size-adjusted) cumulative abnormal returns (CAR) over the post-announcement window for firm groups by *Score5F*. The mean CAR displays a generally increasing trend with this composite drift in the overall sample (column 1), as well as in each of the sub-periods (columns 2 through 4). A hedge strategy of longing the firms with the highest score (*Score5F* = 13) and simultaneously shorting the firms with the lowest score (*Score5F* = -7) earns an average abnormal return of 12.22% per quarter over the whole sample period of 1990-2013. The hedge return is 18.32%, 11.04% and 9.53% for the subperiods of 1990-1997, 1998-2005 and 2006-2013, respectively, all significant at the 0.01 level.

Figure 1 plots by year the mean CAR per quarter earned on hedge portfolios. In Figure

[15] The returns on hedge portfolios are not much affected if we assume the quintile rank of a fundamental factor to have the median value of 3, because hedge portfolios usually do not contain firms in the middle ranges of news.

1A, the hedge portfolio is constructed using firms only in the highest and the lowest score. The mean CAR is positive in 22 of the 24 sample years, with the two loss years being year 1998 (-5.28%) and year 2007 (- 3.07%). The average abnormal return of the 24 years is 12.22% per quarter (48.88% annualized).

In Figure 1B, the hedge portfolio is constructed using firms having the two highest (*Score5F* = 12, 13) and two lowest scores (*Score5F* = -6, -7). The mean abnormal return is positive also in 22 of the 24 sample years. When the strategy is even more broadly based to comprise firms in the three highest and three lowest values of *Score5F*, the number of years with positive mean excess returns increases to 23, as shown in Figure 1C.

Finally, in Figure 1D, we construct the hedge portfolio by taking a long position in the firms in the top decile of *Score5F* and simultaneously a short position in the firms in the bottom decile. The mean abnormal return earned is positive in all 24 years. The average abnormal returns of the 24 years is 5.52% per quarter (or 22.08% annualized).

[Insert Figure 1]

We plot in Figure 2 the time trend of *POSTCAR*, the cumulative daily abnormal returns over the window starting at the 2nd trading day after a quarterly earnings announcement and ending at no later than the 74th trading day (coincided with the window for *POSTCAR*).[16] The plot separates the drift trends by different scores. As is apparent in the figure, prices can either drift upward or drift downward, with *POSTCAR* growing over time in a gradual manner, and the direction and extent of drifting are highly dependent on the composite score, *Score5F*.

[Insert Figure 2]

4.3 Price drifting in relation to the fundamental factors versus earnings news

Prior studies have focused on earnings news to explain price drifting following earnings announcements. In this subsection, we demonstrate that the PEAD phenomenon with respect to earnings news is part, but not the whole, of price adjustment towards released information. Specifically, we show that post-announcement price drifting in relation to our fundamental factors continues to be present after controlling for earnings news. We also show that investment strategies based on the five factors earns abnormal returns that far exceed those

[16] If a firm's earnings announcement date for the next quarter occurs before the 74th trading day after the current quarter announcement, we stop including the firm's return at one day after the next quarterly earnings announcement.

based on earnings news alone.[17]

4.3.1 Controlling for unexpected earnings in regressions

To demonstrate that the fundamental factors introduced in this study have incremental power to explain post-announcement price drifting, we re-run regressions of *POSRCAR* on the (non-earnings) factors after controlling for unexpected earnings.

[Insert Table 4]

Table 4 presents the regression results. In column (1), the coefficient on unexpected earnings (*ue*) is significantly positive, confirming the existence of the PEAD anomaly as documented in the literature before. In columns (2) through (5), where the non-earnings factors are individually used together with unexpected earnings in regressions, the coefficients on *Decile_ub*, *Decile_uq*, *Decile_ug* and *Decile_ur* all have the same signs as previously shown in Table 2 (where we do not control for earnings news), and are significant at 0.01 level. Thus, after controlling for earnings news, price drifting continues to exist in relation to the four other factors: capital investment, profitability, growth opportunities and the discount rate.

Then, in column (6), we include the four factors, measured in decile ranks, simultaneously in a regression, and control for unexpected earnings. The coefficients on *Decile_ub*, *Decile_uq*, *Decile_ug* and *Decile_ur* all remain significant, and their signs are as in the separate regressions. The results are similar in column (7) where we control for unexpected earnings measured by decile ranking. These results confirm that information conveyed by our non-earnings factors contribute to post-announcement price drifting beyond earnings news, and indeed each of the factors—as well as earnings, is at work in causing post-announcement price movement.

4.2.2 Investment portfolios sorted on non-earnings factors versus earnings news

To assess the extent of price drifting in relation to the broader set of fundamental factors versus that in relation to earnings news, we perform several portfolio-based analyses.

Firstly, we independently sort our sample on earnings news (*ue*) and a score computed from the four non-earnings factors, denoted as *Score4F*, which combines the unexpected changes in capital investment, profitability, growth opportunities, the discount rate as follows:

Score4F = - quintile_ub + quintile_uq + quintile_ug - quintile_ur.

This four-factor score has a value ranging from -8 to 8.

[17] In the analyses below, we control for earnings news as proxied by (unscaled) unexpected earnings. Our results are similar if we instead use standardized earnings surprise (i.e., scaled by the beginning price) as commonly used in the PEAD literature.

[Insert Figure 3]

Figure 3 plots the cumulative daily abnormal returns over the post-announcement window for firms grouped by the value of *Score4F*. It is apparent that *Score_4F* has the ability to separate post announcement price drifting along different paths.

[Insert Table 5]

Table 5 presents abnormal returns on the portfolio sorted simultaneously on the quintiles of earnings news (*ue*) and the values of *Score_4F*. The number in each cell is the mean quarterly abnormal returns earned over the drift period. To keep the table concise, we combine earnings news quintiles 2 through 4 and show the combined result in a single row in the table, and also divide the range of *Score_4F* into four groups and show the results in four columns. The two cells shown in bold correspond to the portfolios based on the extreme signals from *ue* and *Score4F* that reinforce each other, that is, either when the two signals both convey extreme negative news or when they both convey extreme positive news.

We make several observations in Table 5. First, in the whole sample, there is an upward trend of price drifting in the post announcement period for firms with extreme positive earnings news (quintile 5 of *ue*), with a mean quarterly abnormal return of 2.63%. However, this upward trend does not hold uniformly across all subgroups further partitioned on *Score4F*. In particular, the mean abnormal return is negative (-0.87%, t=-1.51) for firms in *ue* quintile 5 *and* in the lowest group of *Score4F* (with a value from -8 to -4); that is, there is no under-reaction to good earnings news conditional on an unfavorable signal from *Score4F*.[18] As *Score4F* increases, the mean abnormal return turns positive and increases monotonically.

Likewise, when faced with negative earnings surprises, prices do not always drift downward in the subsequent periods. In *ue* quintile 1 (extreme negative earnings surprises), the mean abnormal return is significantly negative only in the partition with the lowest value of *Score_4F*. It is actually significantly positive for the partition of *Score_4F* with its value between 1 and 4. These results indicate an interactive effect between earnings news and non-earnings factors in causing post-announcement price drifts. In particular, they reveal that the existence of the earnings-based PEAD anomaly as previously document, i.e., under-reaction to earnings news, is not universal; it depends on the nature of news conveyed by non-earnings factors.

Second, Table 5 shows that an investment strategy based jointly on earnings news and

[18] Also note that within the lowest group of *Score4F,* the returns are not significantly different between the highest and lowest *ue* quintile (t=0.95), indicating that the earnings-related PEAD anomaly is not present conditional on an unfavorable signal from *Score4F*.

other fundamental information yields substantially higher returns than that based on earnings news alone. For example, the abnormal return on a hedge strategy of buying firms simultaneously in the highest *ue* quintile and the highest *Score4F* partition while shorting firms simultaneously in the lowest *ue* quintile and the lowest *Score4F* partition yields a return of 6.58% per quarter (5.03% - [-1.55%]). On the other hand, a similar hedge strategy based on the extreme *ue* quintiles (i.e., unconditional on *Score_4F*) yields a return of 2.73% (2.63% - [-0.10%]), less than half of that from the former strategy.

Third, between the two fundamental signals (i.e., earnings versus non-earnings), *Score_4F* more closely tracks the path of investors' price discovery. For example, a strategy of longing firms with high values of *Score_4F* and simultaneously shorting firms with low values of *Score_4F* yields greater returns than does a corresponding strategy based on *ue*. Across the different *ue* groups, a hedge strategy based on the extreme partitions of *Score_4F* as in Table 5 yields a return of 4.06%, 6.04%, and 5.90%. On the other hand, across the different *Score_4F* partitions, a hedge strategy based on *ue* earns a return of 0.68%, 1.47%, 1.67%, and 2.53%, which are well-below the returns on the former strategy.

One potential concern with the above comparisons is that portfolios based on *Score4F* might contain more extreme earnings news, and so the higher hedge returns they yield could actually be driven by the same earnings-based PEAD anomaly as previously documented.

To address this concern, we conduct two further tests. In the first test, we sort the sample firms into decile groups on the five-factor score (*Score5F*), and then construct a hedge portfolio that takes a long position in firms in the top decile of *Score5F* and a short position in firms in the bottom decile. This investment strategy is compared with a similarly constructed hedge portfolio made up of the top and bottom decile groups of *ue*. Due to the equal number of firms included in these two strategies, by construction, firms in the extreme deciles of *Score5F* cannot have more extreme earnings news than those in the extreme deciles of *ue*, thus avoiding the above concern.

Figure 4, Panel A, shows that the investment strategy based on *Score5F* outperforms that based on *ue* in 21 of the 24 sample years. The former strategy yields an average excess returns of 5.70% per quarter (22.80% annualized),[19] compared with 3.22% by the latter strategy (12.88% annualized).[20]

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[19] In order to maintain the same number of observations used in both strategies, we set the quintile rank of a fundamental factor to the median value of 3 in the cases of missing data. For this reason, the average abnormal returns of the investment strategy based on *Score5F* in Figure 4 (5.64% per quarter) is slightly different from the same strategy in Figure 1D (5.52% per quarter)

[20] This hedge return on the earnings-based strategy is comparable to those reported in the prior

In the second test, we partition firms into 25 groups based on the quintile rankings of the five fundamental factors (5×5 = 25). We construct a hedge portfolios that takes a long position in firms simultaneously in the top quintiles of all five factors (which are in the top 1/25th of *Score5F*), and a short position in firms in the bottom 1/25th of *Score5F*.[21] Again, this strategy is compared with a similar portfolio based on earnings news (using the top and bottom 1/5th of *ue*).

[Insert Figure 4]

Figure 4, Panel B, shows that the strategy based on *Score5F* outperforms that based on ue in 19 of the 24 years. The average excess return on the former strategy is 10.90% per quarter, compared with 3.67% by the latter strategy. The results here reinforce the above findings that stock prices adjust to a broad set of fundamental information, including both earnings and non-earnings information, in post-announcement periods, and that price drifting to earnings news is a relatively small part of price adjustment to financial reporting information in general.

5. Robustness Checks

In this section, we conduct further analyses to check the robustness of our findings. First, we re-examine post-announcement price drifts with respect to the five fundamental variables using the Fama-MacBeth approach. Table 6 shows the results of regressing *POSTCAR* on decile ranks of the fundamental variables. Similar to the results shown in Table 4 above, the coefficients on *Decile_UB*, *Decile_UQ*, *Decile_UG* and *Decile_UR* in column (2) through column (5) are all significant, and they have the same signs as in Table 4. Furthermore, when all five variables are included simultaneously in columns (6) and (7), they each have a significant effect. Thus, the results from Fama-Macbeth tests are qualitatively the same as before, that each of the fundamental factors has incremental power to explain post-announcement price drifting.

[insert Table 6]

Asset pricing studies show that a firm's market capitalization (size) and the book-to-market ratio of equity (BM) have power to predict returns. To control for these known factors, and to demonstrate the generality of our results, we partition the overall sample into six subsamples by independently sorting firms on size (2 groups) and book-to-market (3 groups). We then compare the two investment strategies described above, which are based on *Score5F*

literature. For example, the average annualized abnormal returns reported in Collins and Hribar (2000) is 13.8% (annualized) for the period 1988 - 1997.

[21] To make the two strategies more comparable, we put a variable's quintile ranking to the median value of 3 in the cases of missing data. The results are similar if we keep only those firms with no missing data for the five variables.

and *ue*, respectively, in each of the six subsamples. Table 7 shows that the hedge strategy based on *Score5F* generates significantly higher returns than the strategy based on *ue* in all six subsamples. We also discover that the hedge returns are greater in firm groups with small, versus large, market capitalization. This suggests that investors take longer time to absorb fundamental information for small firms than for large firms, possibly because investors pay closer attention to larger firms.

[Insert Table 7]

6. Conclusions

Information about firms' business performance is vital for investors' trading and price discovery. By examining stock price behavior surrounding an earnings reporting event, we seek to uncover direct evidence on how investors process financial reporting data and how efficiently value-relevant information is absorbed into prices. Unlike prior research that focuses on the informational role of earnings, we employ valuation theory to motivate the use of a more comprehensive set of variables of interest to investors, including the basic attributes of operations such as scale and efficiency.

We first provide evidence to show that the fundamental variables we introduce each play a distinctive role in determining initial market reactions at earnings announcements. All five factors have incremental power to explain market reactions, and the directions of their effects are consistent with the theoretical predictions.

Nonetheless, we find that investors do not fully grasp the implications of newly released information quickly, and stock prices undergo a prolonged process of adjustment after earnings announcements. Again, all five factors are at work in swaying post-announcement price movement. We also show that earning-related price drifting shown in the literature captures a portion of the total drifting we document in this study, and the existence of the former phenomenon actually is conditional on signals from the other (non-earnings) fundamental factors. Our evidence suggests that gradual price adjustment is a general characteristic of how markets process fundamental information to discover value, and such price behavior is displayed with respect to all elements of core information for valuation.

The EMH of Fama (1970) has been widely used in finance and accounting research as the benchmark to gauge market efficiency. In the framework of the EMH, investors are expected to process information and incorporate it into prices quickly, and deviations from that scenario are considered as anomalies or evidence of market inefficiency. The EMH is predicated on the assumption that information arriving to the market is a direct signal of cash flow and firm value,

and so investors require little time to decipher it. However, this abstract way to represent information does not well capture the actual information dissemination process. In practice, firms disclose operation-level data, which are not value proxies, and it is a complex and time consuming process for investors to map financial reporting data to firm value. Thus, from the perspective of how firms conduct activities in real economy to generate value and how operational data need to be processed by investors, it is not clear that we can reasonably expect investors to quickly decipher fundamental information and understand its valuation implications.

This study enhances our understanding of how, in the actual market setting, investors extract value relevant information from reported financial data and how efficiently markets operate to discover prices. Emerging from this study is a view that the actual process of price discovery is distinctly different from what is portrayed by the EMH, and we touch on the possible economic reasons for the divergence. Finally, our study conveys the message that academic researchers and financial reporting standard setters can play important roles in improving the informational efficiency of capital markets, for example, by developing models to better explicate the valuation role of accounting data and by designing standards to further enhance and sharpen the information content of financial reports.

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TABLE 1 Summary Statistics

This table reports the distributional statistics of the main variables (Panel A) and the correlations between the variables (Panel B). The cumulative abnormal return for the announcement window (*CAR[-1,1]*) is the abnormal return accumulated over the three-day window [−1,+1] centered on the earnings announcement date of the current quarter. The abnormal return is equal to the raw return minus the compounded benchmark return of the same CRSP size decile and the same CRSP exchange index (NYSE/AMEX or NASDAQ) that the firm belongs to. The cumulative abnormal return for the drift window (*POSTCAR*) is the abnormal return cumulated from two days after an earnings announcement through to one day after the next quarterly earnings announcement. *Decile_ue*, *Decile_ub, Decile_uq, Decile_ug* and *Decile_ur* are the decile ranks of unexpected changes in the fundamental factors: earnings yield, equity capital investment, profitability, growth opportunities and discount rates. Earnings surprise (*ue*) is defined as the difference in income before extraordinary items between the current quarter and the same quarter of the prior year, scaled by the shares outstanding at the end of the current quarter. *SIZE* is the logarithm of market value of equity in millions of U.S. dollars at the beginning of the quarter. *MTB* is the ratio of market value of equity to book value of equity at the beginning of the quarter. *BETA* is the slope estimate from a market model regression for firms with a daily return one year before the earnings announcement (trading days -251 to -2). *PRERET* is the 3-month buy-and-hold return (skipping the most recent month) before earnings announcements, adjusted for the contemporaneous buy-and-hold value-weighted market index return before the earnings announcement. The sample consists of 393,018 firm-quarter observations over the period 1990–2013 (24 years).

Panel A Descriptive statistics for main variables

Variable	N	Mean	Std. Dev.	10th Pctl.	25th Pctl.	Median	75th Pctl.	90th Pctl.
CAR[-1,1]	393018	0.0025	0.0812	-0.0872	-0.0347	0.0011	0.0388	0.0928
POSTCAR	393018	0.0154	0.2310	-0.2380	-0.0979	0.0111	0.1250	0.2730
Decile_ue	390850	-0.0017	0.3200	-0.5000	-0.2780	-0.0556	0.2780	0.5000
Decile_ub	389115	-0.0012	0.3200	-0.5000	-0.2780	-0.0556	0.2780	0.5000
Decile_uq	362839	-0.0001	0.3200	-0.5000	-0.2780	-0.0556	0.2780	0.5000
Decile_ug	361707	-0.0002	0.3210	-0.5000	-0.2780	-0.0556	0.2780	0.5000
Decile_ur	251997	0.0017	0.3210	-0.5000	-0.2780	0.0556	0.2780	0.5000
ue	390850	0.0111	0.4710	-0.3090	-0.0771	0.0230	0.1210	0.3220
SIZE	391512	5.7400	1.9980	3.1620	4.2340	5.6450	7.1140	8.4250
MtoB	390131	2.8130	3.1830	0.7580	1.1560	1.8270	3.1190	5.5880
Beta	393008	0.8410	0.6110	0.1090	0.3790	0.7840	1.2270	1.6640
PRERET	392909	0.0077	0.2450	-0.2630	-0.1280	-0.0106	0.1130	0.2800

Panel B Correlation matrix

	CAR[-1,1]	*POSTCAR*	*Decile_ub*	*Decile_uq*	*Decile_ug*	*Decile_ur*
CAR[-1,1]	1					
POSTCAR	0.040***	1				
Decile_ub	0.022***	-0.031***	1			
Decile_uq	0.156***	0.048***	0.086***	1		
Decile_ug	0.092***	0.029***	0.075***	0.290***	1	
Decile_ur	-0.007***	-0.030***	-0.018***	-0.074***	0.119***	1
Decile_ue	0.160***	0.045***	0.198***	0.767***	0.267***	-0.065***
ue	0.102***	0.027***	0.154***	0.592***	0.187***	-0.043***
SIZE	-0.005***	-0.063***	0.184***	0.030***	0.028***	0.053***
MtoB	-0.023***	-0.027***	0.090***	0.032***	0.020***	-0.020***
Beta	-0.019***	-0.030***	0.124***	-0.001	-0.033***	0.00100
PRERET	0.016***	-0.003**	0.070***	0.146***	0.099***	-0.033***

	Decile_ue	*ue*	*SIZE*	*MtoB*	*Beta*	*PRERET*
Decile_ue	1					
ue	0.712***	1				
SIZE	0.129***	0.058***	1			
MtoB	0.048***	0.033***	0.189***	1		
Beta	0.023***	0.002	0.356***	0.158***	1	
PRERET	0.162***	0.111***	0.099***	0.156***	-0.005***	1

TABLE 2 Explaining immediate market reactions and subsequent price drifts using the fundamental factors

This table reports the results of the following regression models:

Panel A: $CAR[-1,1]_{jt} = \alpha + \beta\ Decile\_var_{jt} + \gamma\ Controls_{jt} + YEAR + INDUSTRY + e_{jt}$

Panel B: $POSTCAR_{jt} = \alpha + \beta\ Decile\_var_{jt} + \gamma\ Control_{jt} + YEAR + INDUSTRY + e_{jt}$,

CAR[-1,1] is the abnormal return accumulated over the three-day window [−1,+1] centered on the earnings announcement date for firm j in quarter *t*. *POSTCAR* is the abnormal return accumulated from two days after an earnings announcement through one day after the next quarterly earnings announcement. ***Decile_var*** refers to the decile rank of a fundamental factor (*Decile_ue*, *Decile_ub, Decile_uq, Decile_ug* or *Decile_ur*), which is measured by sorting firms in a quarter into decile groups on unexpected changes in the factor (earnings yield, equity capital investment, profitability, growth opportunity, or the discount rate). ***Controls*** are control variables including firm size (*SIZE*); market to book ratio (*MTB*); market model beta (*BETA*); and return momentum (*PRERET*). *YEAR* and *INDUSTRY* represent year and industry fix effect, respectively. See Appendix B for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. Robust t-statistics clustered by stocks are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels (2-tailed), respectively.

Panel A The market reaction in the announcement window					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	*CAR[-1,1]*	*CAR[-1,1]*	*CAR[-1,1]*	*CAR[-1,1]*	*CAR[-1,1]*
Intercept	0.0143***	0.0113***	0.0100***	0.0101***	0.0110***
	(8.451)	(6.135)	(5.238)	(5.155)	(4.900)
Decile_ue	**0.0415*** **				
	(75.708)				
Decile_ub		**0.0055*** **			
		(11.708)			
Decile_uq			**0.0397*** **		
			(68.109)		
Decile_ug				**0.0228*** **	
				(45.956)	
Decile_ur					**-0.0015*** **
					(-2.670)
SIZE	-0.0005***	0.0002**	0.0002**	0.0002*	0.0001
	(-6.198)	(2.241)	(2.437)	(1.768)	(0.896)
MtoB	-0.0007***	-0.0007***	-0.0008***	-0.0007***	-0.0006***
	(-13.678)	(-12.543)	(-13.166)	(-12.250)	(-9.489)
Beta	-0.0020***	-0.0025***	-0.0021***	-0.0014***	-0.0021***
	(-6.896)	(-8.074)	(-6.582)	(-4.511)	(-5.460)
PRERET	-0.0018***	0.0059***	-0.0019**	0.0026***	0.0050***
	(-2.578)	(8.170)	(-2.562)	(3.427)	(5.636)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	389357	386376	360390	359165	250155
Adjusted R-squared	0.0277	0.0025	0.0266	0.0101	0.0022

Panel B Post-announcement abnormal returns					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*
Intercept	0.0849***	0.0799***	0.0799***	0.0789***	0.0819***
	(13.206)	(12.402)	(12.671)	(12.439)	(13.520)
Decile_ue	**0.0411*** **				
	(32.979)				
Decile_ub		**-0.0144*** **			
		(-10.717)			
Decile_uq			**0.0364*** **		
			(25.689)		
Decile_ug				**0.0223*** **	
				(16.940)	
Decile_ur					**-0.0181*** **
					(-11.812)
SIZE	-0.0071***	-0.0059***	-0.0065***	-0.0064***	-0.0060***
	(-28.418)	(-24.166)	(-25.733)	(-25.517)	(-20.206)
MtoB	-0.0016***	-0.0015***	-0.0016***	-0.0015***	-0.0014***
	(-9.622)	(-8.404)	(-8.528)	(-8.549)	(-6.891)
Beta	-0.0049***	-0.0045***	-0.0037***	-0.0033***	-0.0046***
	(-5.769)	(-5.176)	(-4.193)	(-3.734)	(-4.176)
PRERET	-0.0051**	0.0040**	-0.0056***	-0.0021	0.0016
	(-2.482)	(1.964)	(-2.595)	(-0.969)	(0.635)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	389357	386376	360390	359165	250155
Adjusted R-squared	0.0105	0.0078	0.0104	0.0090	0.0082

TABLE 3 Mean abnormal returns over the post-announcement window by the composite drift score from the five fundamental factors

This table presents the average accumulated daily abnormal returns over the drift window. Abnormal returns are measured using size-adjusted returns. The sample firms are sorted on the drift score (*Score5F)* constructed by summing the quintile ranks of five fundamental factors (earnings, equity capital investment, profitability, growth opportunity, and the discount rate):

Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug – quintile_ur

Quintile-sorting for a quarter is performed using the cutoff points set in the previous quarter. *t*-statistics are in parenthesis.

	(1)	(2)	(3)	(4)
Score5F	Overall 1990-2013	1990-1997	1998-2005	2006 -2013
-7 (small)	-0.0421	-0.0988	-0.0267	-0.0249
-6	-0.0210	-0.0409	-0.0237	-0.0036
-5	-0.0133	-0.0138	-0.0249	-0.0020
-4	-0.0134	-0.0174	-0.0251	0.0007
-3	-0.0080	0.0024	-0.0193	-0.0042
-2	-0.0041	-0.0032	-0.0089	0.0004
-1	0.0007	0.0040	-0.0059	0.0052
0	0.0036	0.0140	-0.0081	0.0075
1	0.0060	0.0131	0.0046	0.0011
2	0.0111	0.0190	0.0078	0.0073
3	0.0153	0.0204	0.0152	0.0106
4	0.0166	0.0224	0.0173	0.0107
5	0.0245	0.0304	0.0296	0.0140
6	0.0273	0.0343	0.0282	0.0201
7	0.0299	0.0367	0.0337	0.0199
8	0.0377	0.0424	0.0427	0.0282
9	0.0437	0.0562	0.0462	0.0286
10	0.0479	0.0621	0.0534	0.0283
11	0.0584	0.0778	0.0568	0.0415
12	0.0573	0.0725	0.0574	0.0445
13 (large)	0.0801	0.0844	0.0838	0.0703
large – small	0.1222***	0.1832***	0.1104***	0.0953***
t-statistic	(5.41)	(4.39)	(2.72)	(3.16)

TABLE 4 Explaining post-announcement abnormal returns by the fundamental factors controlling for earnings surprise

This table reports the results of the following regression models:

$$POSTCAR_{jt} = \alpha + \beta\ Decile\_var_{jt} + \gamma\ ue_{jt} + \theta\ Controls_{it} + YEAR + INDUSTRY + e_{jt},$$

POSTCAR is the abnormal return accumulated from two days after an earnings announcement through one day after the next quarterly earnings announcement. *Decile_var* refers to the decile rank of a fundamental factor (*Decile_ue*, *Decile_ub, Decile_uq, Decile_ug*, *Decile_ur*), which is measured by sorting firms in a quarter into decile groups on unexpected changes in the factor (earnings yield, equity capital investment, profitability, growth opportunity, or the discount rate). *ue* is earnings surprise defined as the difference in income before extraordinary items between the quarter and the same quarter of the prior year, scaled by the share outstanding at the end of the quarter. *Controls* represents control variables including firm size (*SIZE*), measured as the logarithm of the market value of equity in millions of U.S. dollars at the beginning of the quarter; Market to book ratio (*MTB*), measured as the ratio of the market value of equity to the book value of equity at the beginning of the quarter; market model beta (*BETA*), estimated from regressing daily stock returns on daily value-weighted market index returns during the 1-year period before the earnings announcement; and return momentum (*PRERET*), measured as the three-month buy-and-hold returns (skipping the most recent month) before earnings announcements, adjusted for contemporaneous buy-and-hold, value weighted market index returns. *YEAR* and *INDUSTRY* represent year and industry fix effect respectively. Robust *t*-statistics clustered by stocks are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels (2-tailed), respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*
Intercept	0.0822***	0.0803***	0.0801***	0.0798***	0.0828***	0.0785***	0.0803***
	(12.702)	(12.566)	(12.693)	(12.650)	(13.788)	(13.102)	(13.512)
Decile_ub		**-0.0181*** **				**-0.0151*** **	**-0.0181*** **
		(-13.335)				**(-8.993)**	**(-10.520)**
Decile_uq			**0.0347*** **			**0.0343*** **	**0.0165*** **
			(19.200)			**(15.217)**	**(6.008)**
Decile_ug				**0.0187*** **		**0.0169*** **	**0.0162*** **
				(14.026)		**(10.034)**	**(9.632)**
Decile_ur					**-0.0172*** **	**-0.0173*** **	**-0.0170*** **
					(-11.229)	**(-10.829)**	**(-10.677)**
Decile_ue							**0.0218*** **
							(9.020)
ue	0.0164***	0.0180***	0.0020*	0.0138***	0.0134***	-0.0007	
	(18.082)	(19.633)	(1.696)	(14.662)	(13.410)	(-0.491)	
SIZE	-0.0064***	-0.0060***	-0.0065***	-0.0066***	-0.0062***	-0.0062***	-0.0065***
	(-26.070)	(-24.893)	(-25.797)	(-26.182)	(-20.829)	(-20.723)	(-21.476)
MtoB	-0.0016***	-0.0015***	-0.0016***	-0.0015***	-0.0014***	-0.0013***	-0.0013***
	(-9.284)	(-8.354)	(-8.541)	(-8.683)	(-6.997)	(-5.440)	(-5.604)
Beta	-0.0050***	-0.0041***	-0.0037***	-0.0032***	-0.0045***	-0.0019*	-0.0019*
	(-5.811)	(-4.764)	(-4.177)	(-3.648)	(-4.092)	(-1.734)	(-1.668)
PRERET	-0.0005	0.0006	-0.0057***	-0.0045**	-0.0013	-0.0088***	-0.0096***
	(-0.268)	(0.283)	(-2.633)	(-2.109)	(-0.520)	(-3.317)	(-3.620)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	389357	385710	360390	359130	250146	230721	230721
Adjusted R-squared	0.0084	0.0091	0.0104	0.0098	0.0091	0.0126	0.0130

TABLE 5 Post-announcement abnormal returns on portfolios sorted on the four-factor score and earnings news

This table reports the mean (size-adjusted) buy-and-hold cumulative daily abnormal returns over one quarter after earnings announcements on portfolios sorted simultaneously on earnings surprises (*ue*) and the four-factor drift score (*Score4F)* constructed by summing the quintile ranks of the four non-earnings factors (capital investment, profitability, growth opportunities and discount rates): *Score4F = - quintile_ub + quintile_uq + quintile_ug - quintile_ur*. The mean values of cumulative abnormal returns are computed across all quarters from year 1990 to year 2013. The cells in bold correspond to represent observations that have congruent signals of prediction for abnormal returns. *t*-statistics are reported in parentheses, and the numbers of observations are in square brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels (2-tailed), respectively.

		quintile_ue				
		1 (low)	2 to 4	5 (high)	all	high - low
Score4F	-8 to -4 (low)	**-1.55%*** **	-0.38%*	-0.87%	-0.92%***	0.68%
		(-5.84)	(-1.66)	(-1.51)	(-5.46)	(0.95)
		[11,141]	[13,041]	[1,700]	[25,882]	
	-3 to 0	0.08%	1.04%***	1.55%***	0.84%***	1.47%***
		(0.49)	(11.46)	(9.16)	(11.27)	(5.64)
		[29,936]	[61,013]	[14,524]	[105,473]	
	1 to 4	1.17%***	2.83%***	2.84%***	2.68%***	1.67%***
		(3.91)	(26.14)	(20.60)	(32.62)	(5.52)
		[8,222]	[51,102]	[28,571]	[87,895]	
	5 to 8 (high)	2.50%	5.66%***	**5.03%*** **	5.28%***	2.53%
		(0.89)	(12.99)	**(15.16)**	(19.88)	(1.11)
		[144]	[5,483]	[6,604]	[12,231]	
	all	-0.10%	1.79%***	2.63%***		2.73%***
		(-0.80)	(26.83)	(26.83)		(16.98)
		[49443]	[130639]	[51399]		
	high - low	4.06%*	6.04 %***	5.90%***	6.21%***	
		(1.72)	(13.38)	(8.23)	(20.45)	

TABLE 6 Fama-MacBeth test: Explaining post-announcement abnormal returns by the fundamental factors controlling for earnings surprise

This table reports the results of the following regression models using Fama-MacBeth method:

$POSTCAR_{jt} = \alpha + \beta\ Decile\_var_{jt} + \gamma\ ue_{jt} + \theta\ Controls_{it} + YEAR + INDUSTRY + e_{jt}$,

POSTCAR is the abnormal return accumulated from two days after an earnings announcement through one day after the next quarterly earnings announcement. *Decile_var* refers to the decile rank of a fundamental factor (*Decile_ue*, *Decile_ub, Decile_uq, Decile_ug*, *Decile_ur*), which is measured by sorting firms in a quarter into decile groups on unexpected changes in the factor (earnings yield, equity capital investment, profitability, growth opportunity, or the discount rate). *ue* is earnings surprise defined as the difference in income before extraordinary items between the quarter and the same quarter of the prior year, scaled by the share outstanding at the end of the quarter. *Controls* represents control variables including firm size (*SIZE*), measured as the logarithm of the market value of equity in millions of U.S. dollars at the beginning of the quarter; Market to book ratio (*MTB*), measured as the ratio of the market value of equity to the book value of equity at the beginning of the quarter; market model beta (*BETA*), estimated from regressing daily stock returns on daily value-weighted market index returns during the 1-year period before the earnings announcement; and return momentum (*PRERET*), measured as the three-month buy-and-hold returns (skipping the most recent month) before earnings announcements, adjusted for contemporaneous buy-and-hold, value weighted market index returns. *YEAR* and *INDUSTRY* represent year and industry fix effect respectively. Robust *t*-statistics of Fama-MacBath regression are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels (2-tailed), respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*	*POSTCAR*
Intercept	0.0583***	0.0560***	0.0602***	0.0601***	0.0546***	0.0550***	0.0570***
	(13.519)	(12.702)	(13.844)	(13.638)	(11.581)	(11.593)	(11.861)
Decile_ub		**-0.0177*** **				**-0.0137*** **	**-0.0162*** **
		(-5.023)				**(-3.890)**	**(-4.584)**
Decile_uq			**0.0357*** **			**0.0321*** **	**0.0174*** **
			(11.672)			**(10.037)**	**(4.388)**
Decile_ug				**0.0176*** **		**0.0166*** **	**0.0158*** **
				(7.297)		**(6.818)**	**(6.601)**
Decile_ur					**-0.0177*** **	**-0.0177*** **	**-0.0175*** **
					(-9.749)	**(-9.696)**	**(-9.516)**
Decile_ue							**0.0231*** **
							(6.788)
ue	0.0198***	0.0216***	0.0043**	0.0175***	0.0177***	0.0034**	
	(12.264)	(14.357)	(2.434)	(11.668)	(10.805)	(2.217)	
SIZE	-0.0075***	-0.0072***	-0.0077***	-0.0078***	-0.0069***	-0.0070***	-0.0074***
	(-9.248)	(-9.406)	(-9.472)	(-9.683)	(-9.130)	(-9.638)	(-10.048)
MtoB	-0.0009**	-0.0008*	-0.0010**	-0.0009**	-0.0008**	-0.0006	-0.0006
	(-2.152)	(-1.852)	(-2.212)	(-2.258)	(-2.034)	(-1.443)	(-1.423)
Beta	0.0011	0.0021	0.0023	0.0023	-0.0003	0.0016	0.0015
	(0.211)	(0.394)	(0.418)	(0.431)	(-0.067)	(0.324)	(0.288)
PRERET	-0.0048	-0.0035	-0.0109	-0.0079	-0.0023	-0.0110*	-0.0119*
	(-0.712)	(-0.540)	(-1.592)	(-1.173)	(-0.360)	(-1.684)	(-1.828)
Observations	389357	385710	360390	359130	250146	230721	230721
R-squared	0.0321	0.0348	0.0359	0.0347	0.0315	0.0405	0.0411

TABLE 7 Returns on hedge portfolios based on the composite drift score (Score5F) by size and market-to-book groups

This table reports the cumulative abnormal returns on a hedge portfolio that take a long (offsetting short) position in firms in the top (bottom) decile of *Score5F* which equals sum of the quintile ranks of the five fundamental factors (earnings, capital investment, profitability, growth opportunity, and discount rates): *Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur.* The mean values of cumulative abnormal returns are computed as the means across all quarters from year 1990 to 2013. *t*-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% levels (2-tailed), respectively.

			MB		
			Low	Medium	High
Size	Big	Top decile	1.81%	1.74%	1.17%
		Bottom decile	-0.56%	-0.11%	-1.10%
		Diff	2.37%***	1.85%***	2.27%***
		t-statistics	(3.40)	(3.88)	(4.79)
	Small	Top decile	7.68%	7.50%	5.33%
		Bottom decile	-0.66%	-0.78%	-1.58%
		Diff	8.34%***	8.28%***	6.90%***
		t-statistics	(13.62)	(11.27)	(7.79)

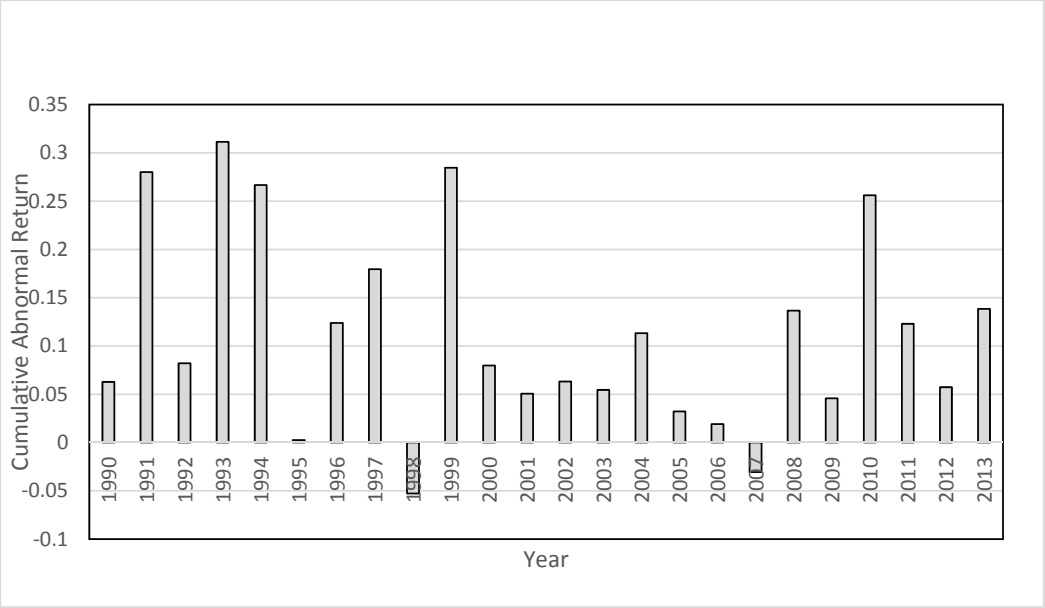

Figure 1A Hedge portfolio returns by year based on all five fundamental factors

This figure show the cumulative abnormal returns on a strategy of taking a long (offsetting short) position in firms with the largest (smallest) value of *Score5F* that combines news from the five fundamental factors (earnings, equity capital investment, profitability, growth opportunity and discount rates) measured in quintile rankings: *Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur*.

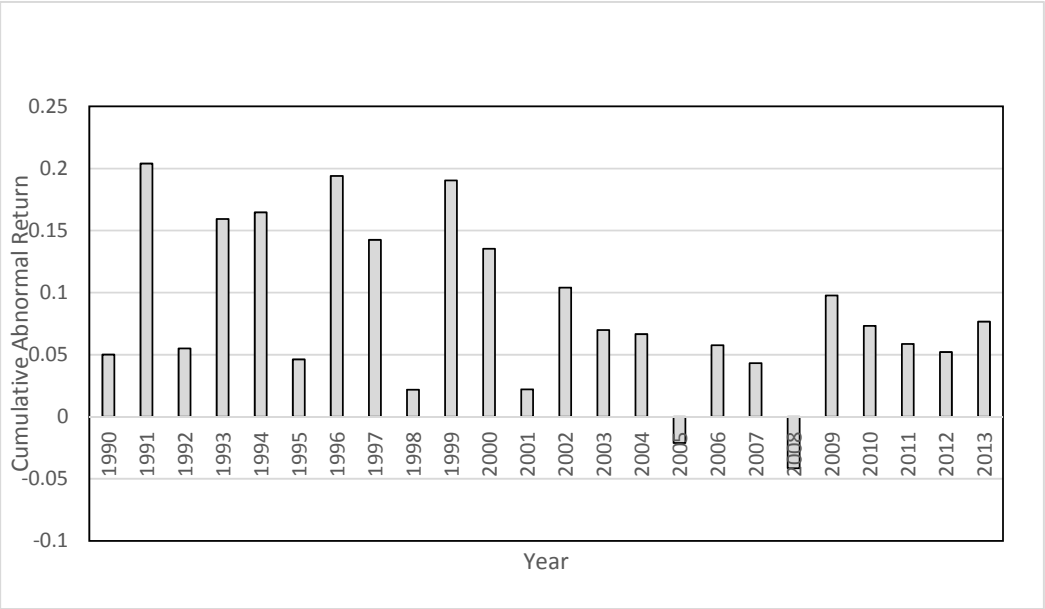

Figure 1B Hedge portfolio returns by year based on all five fundamental factors

This figure show the cumulative abnormal returns on a strategy of taking a long (offsetting short) position in firms with the two largest (smallest) values of *Score5F* that combines news from the five fundamental factors (earnings, equity capital investment, profitability, growth opportunity and discount rates) measured in quintile rankings:*Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur*.

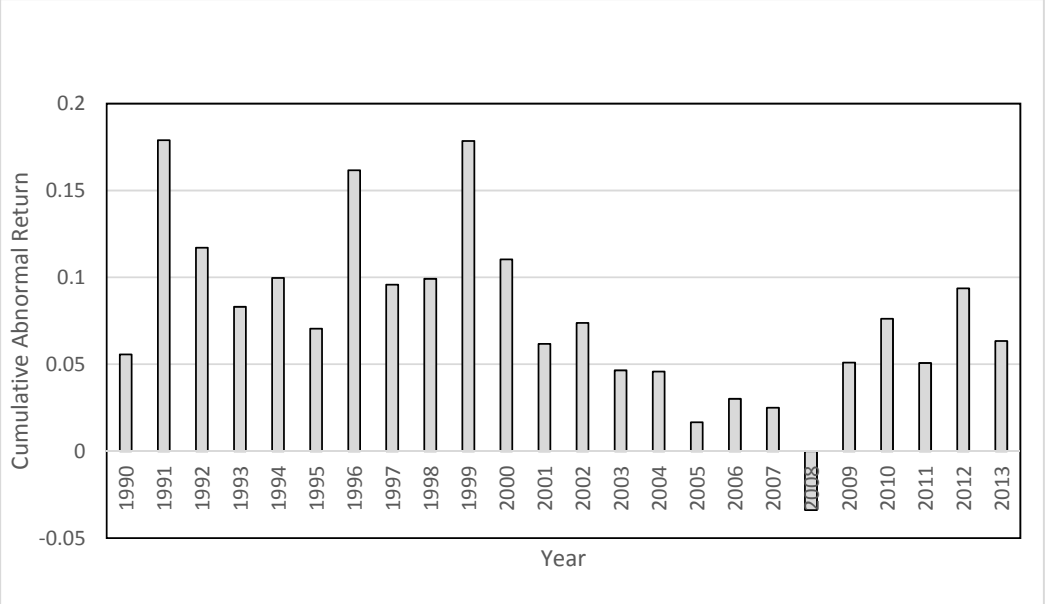

Figure 1C Hedge portfolio returns by year based on all five fundamental factors

This figure show the cumulative abnormal returns on a strategy of taking a long (offsetting short) position in firms with the three largest (smallest) values of *Score5F* that combines news from the five fundamental factors (earnings, equity capital investment, profitability, growth opportunity and discount rates) measured in quintile rankings: *Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur*.

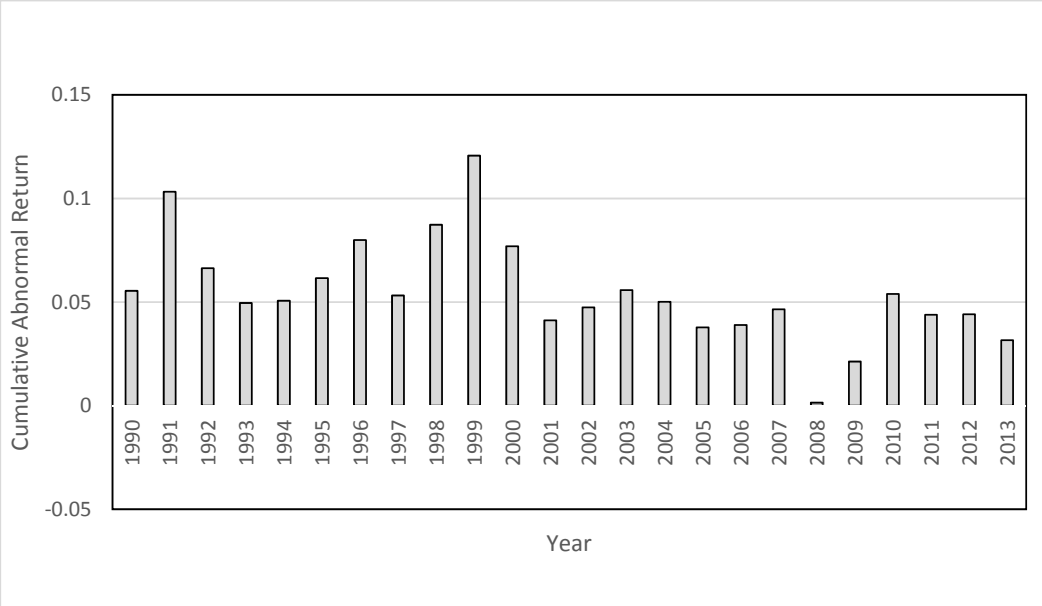

Figure 1D Hedge portfolio returns by year based on all five fundamental factors

This figure show the cumulative abnormal returns on a strategy of taking a long (offsetting short) position in firms in the top (bottom) decile group of *Score5F* that combines news from the five fundamental factors (earnings, equity capital investment, profitability, growth opportunity and discount rates) measured in quintile rankings: *Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur*.

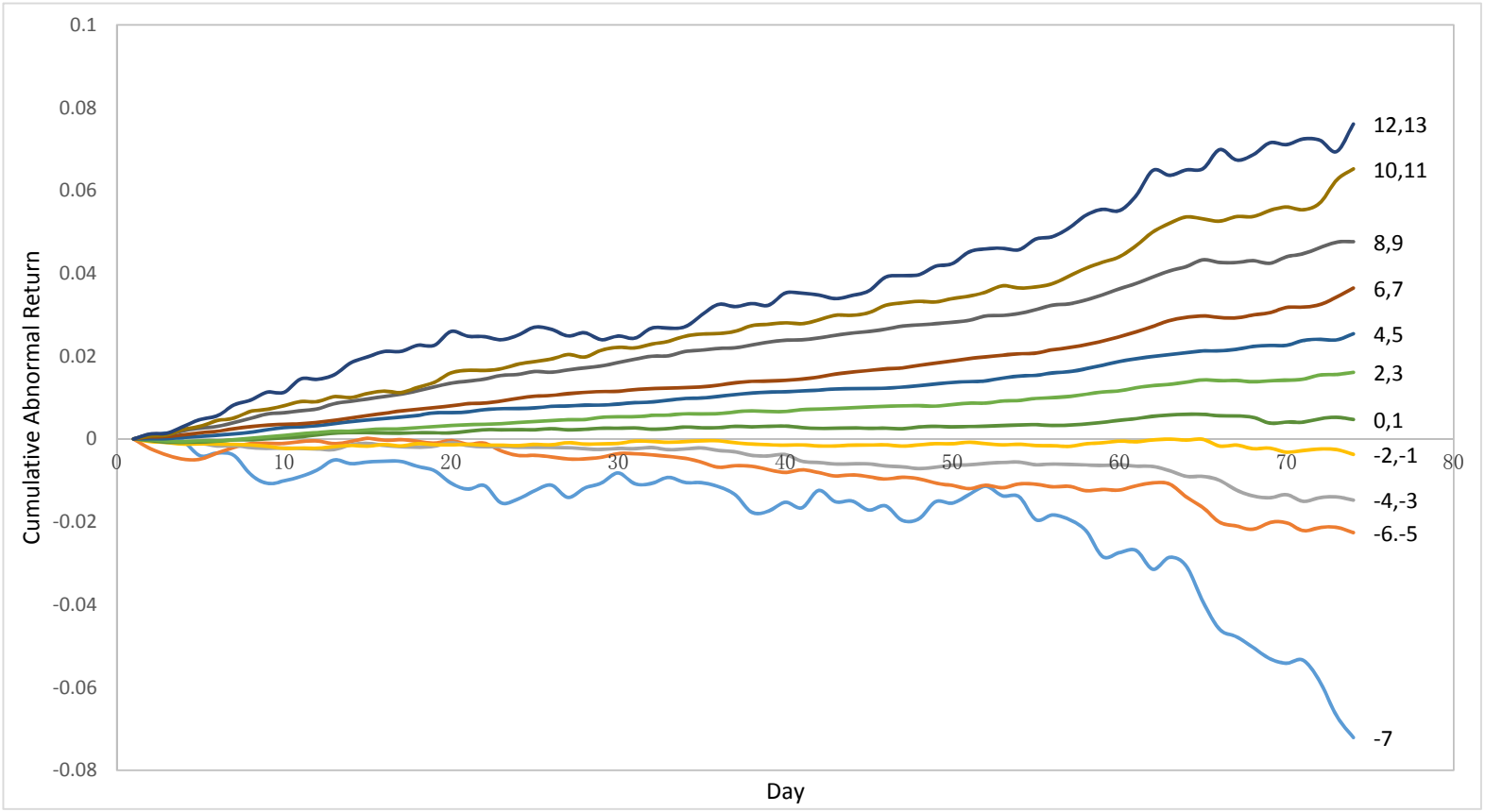

Figure 2 Time trends of *POSTCAR* by groups of *Score5F* values

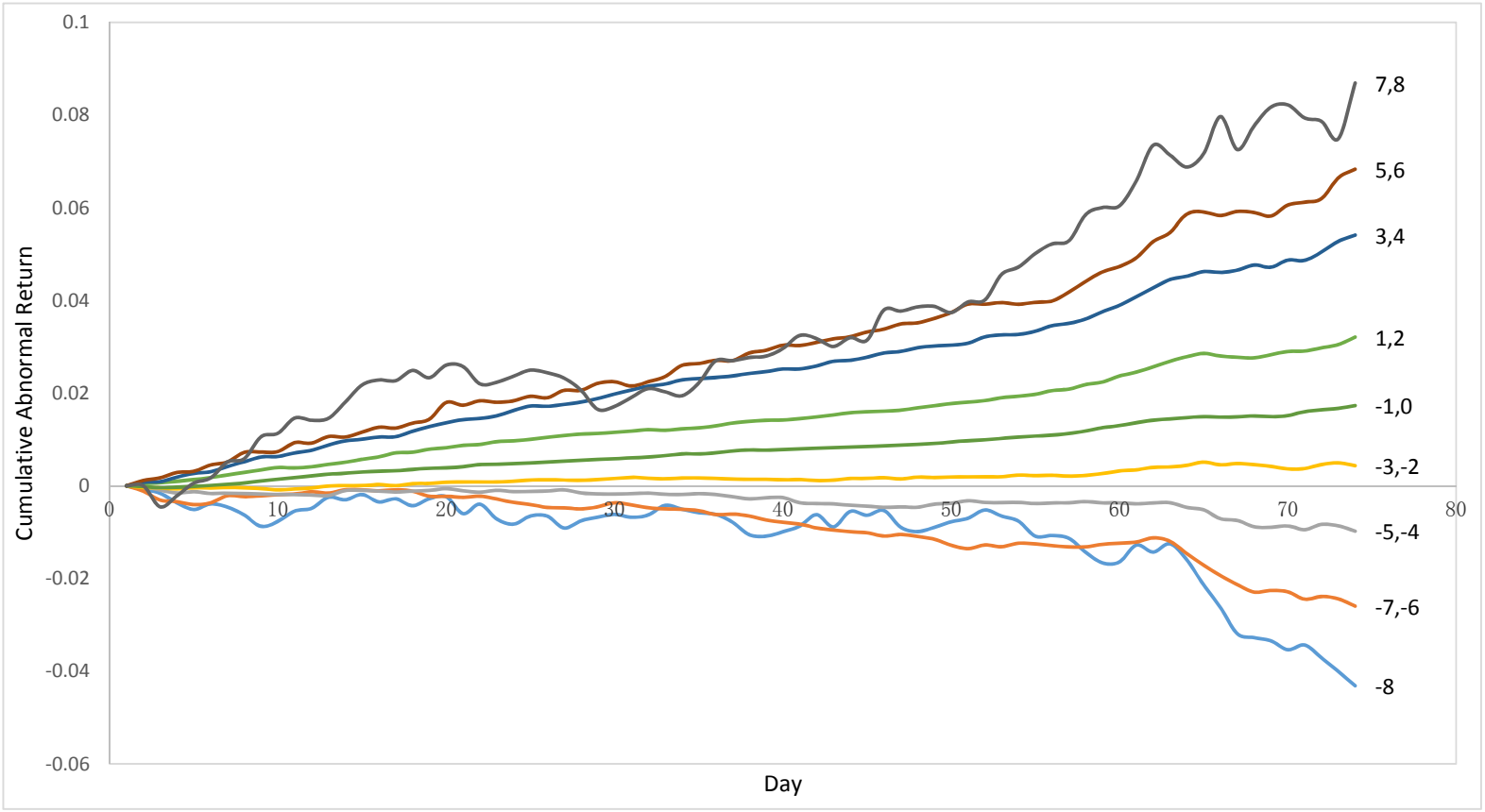

Figure 3 Time trends of *POSTCAR* by groups of *Score4F* values

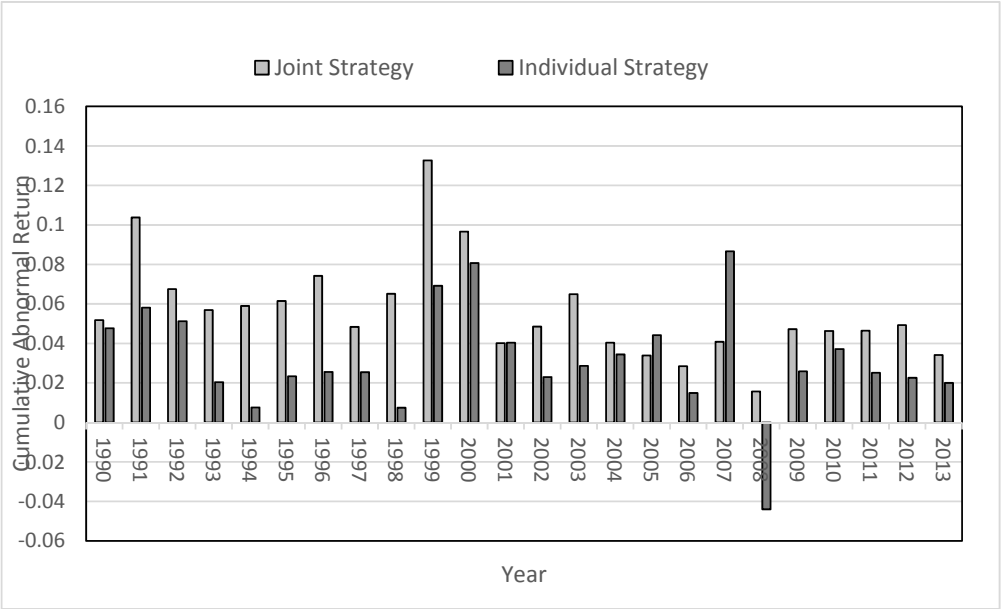

Figure 4A Hedge portfolio returns by year: joint strategy vs. individual strategy

The joint strategy in Figure 4A takes a long (offsetting short) position in firms in the top (bottom) decile group of *Score5F* constructed by summing the five fundamental factors (earnings, equity capital investment, profitability, growth opportunity, and the discount rate) measured in quintile rankings: *Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur*. The individual strategy in Figure 4A takes a long (offsetting short) position in firms in the top (bottom) decile group of unexpected earnings (*ue*).

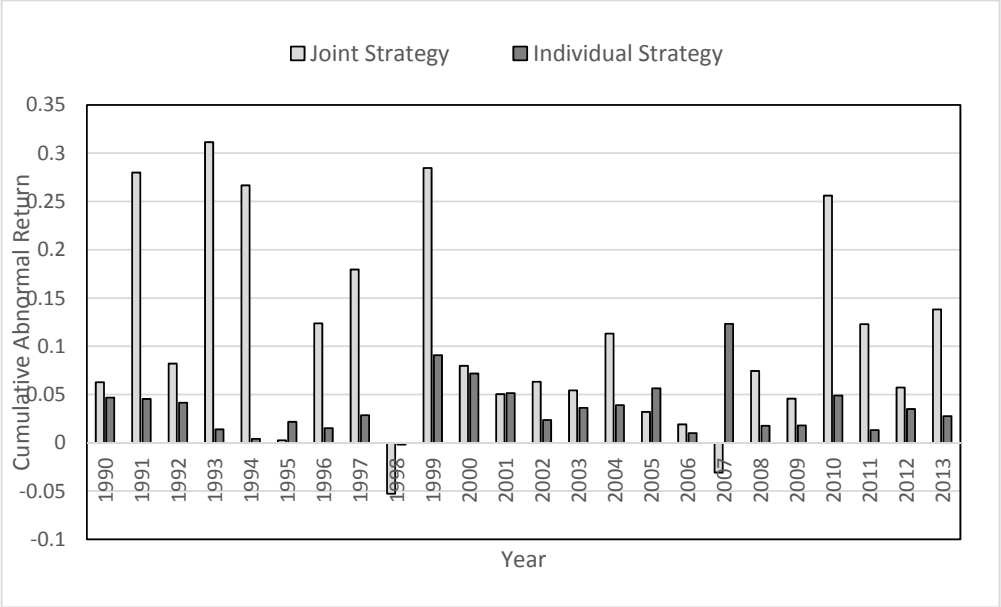

Figure 4B Hedge portfolio returns by year: joint strategy vs. individual strategy

The joint strategy in Figure 4B takes a long (offsetting short) position in firms in the top (bottom) 25th group of *Score5F* constructed by summing the five fundamental factors (earnings, equity capital investment, profitability, growth opportunity, and the discount rate) measured in quintile rankings: *Score5F = quintile_ue – quintile_ub + quintile_uq + quintile_ug - quintile_ur*. The individual strategy in Figure 4B takes a long (offsetting short) position in firms in the top (bottom) 25th group of unexpected earnings (*ue*).

Appendix A. Sample Selection

Selection criteria	1990 - 2013
Population	880,789
Step 1: exclude observations without sufficient data to calculate any one of the five fundamental factors.	154,685
Step 2: exclude observations without earnings announcement date in Compustat, or with a report date not within 60 calendar days around the quarter-end date.	160,895
Step 3: exclude firms that cannot be linked to stock return data in CRSP	84,889
Step 4: exclude observations with earnings report dates in Compustat and in I/B/E/S (if available) differ by more than one calendar day, or with the report date larger than the next consecutive report date.	51,817
Step 5: exclude firms with shares not traded on the NYSE/AMSE/NASDAQ, or without sufficient return data to calculate cumulative abnormal returns.	14,678
Step 6: exclude firms for which the market value of equity at the beginning of the quarter is not available or is not larger than $5 million; exclude firms with non-positive book value of equity.	20,807
Sample	**393,018**
Step 7: exclude firms with missing control variables	2,995
Sample used for regressions	**390,023**
sample with data available for unexpected earnings	389,357
sample with data available for unexpected book value change	386,376
sample with data available for unexpected roe change	360,390
sample with data available for unexpected change in sales growth	359,165
sample with data available for unexpected change in discount rate	250,155
sample with data available for all five accounting variables	230,721

Appendix B. Variable Definitions

Main variables	
CAR[-1,1]	Cumulate abnormal returns over the announcement window [-1, +1], adjusted for the raw return on the benchmark index of firms in the same CRSP size decile and on the same CRSP exchange (NYSE/AMEX or NASDAQ) that the firm belongs to.
POSTCAR	Cumulate abnormal returns over the post announcement window, adjusted for the raw return on the benchmark index of firms in the same CRSP size decile and on the same CRSP exchange (NYSE/AMEX or NASDAQ) that the firm belongs to. We accumulated from two days after an earnings announcement through one day after the next quarterly earnings announcement. We adjust the period to a month if the announcement gap is less than a month, and adjust the period to [+2,+74] trading days if the announcement gap is larger.
Decile_ub	Decile ranking of the unexpected change in equity book value, with firms sorted on $(B_t - B_{t-4})/B_{t-4}$ each quarter, where B is the book value of equity. The rankings are transformed to have a value from -0.5 to 0.5 with median 0.
Decile_uq	Decile ranking of the unexpected change in profitability, with firms sorted on $ROE_t - ROE_{t-4}$ each quarter, where ROE is the return on equity book value at the beginning of a quarter. The rankings are transformed to have a value from -0.5 to 0.5 with median 0.
Decile_ug	Decile ranking of the unexpected change in profitability, with firms sorted on $(Sales_t - Sales_{t-4})/Sales_{t-4} - (Sales_{t-4} - Sales_{t-8})/Sales_{t-8}$ each quarter, where $Sales_t$ is sales revenues in quarter t. The rankings are transformed to have a value -0.5 to 0.5 with median 0.
Decile_ur	Decile ranking of the unexpected change in the discount rate, with firms sorted on $(XINT_t - XINT_{t-4})/XINT_{t-4}$ each quarter, where $XINT_t$ is interest and related expenses in quarter t. The rankings are transformed to have a value from -0.5 to 0.5 with median 0.
Decile_ue	The decile rank of unexpected earnings, with firms sorted on $EPS_t - EPS_{t-4}$ each quarter. The rankings are transformed to have a value -0.5 to 0.5 with median 0.
Control variables	
ue	Unexpected earnings, calculated as the change of income before extraordinary items between quarter t and t-4, divided by common shares outstanding in quarter t.
SIZE	Natural logarithm of market value in millions of U.S. dollars at the end of a fiscal year.
MTB	Ratio of market value of equity to book value of equity at the end of a fiscal year.
BETA	Estimate of the slope coefficient from a market model regression using daily returns in the 250 trading days before the earnings announcement
PRERET	Return momentum measured as the 3-month buy-and-hold return adjusted for market return (skipping one month) before the earnings announcement.
INDUSTRY	Indicator of Fama-French 48 industries membership.
YEAR	Indicator of years.