Portfolio Allocations Using Fundamental Ratios: *Are Profitability Measures More Effective in Selecting Firms and Sectors?*

J. Christopher Hughen and Jack Strauss

J. Christopher Hughen
is an associate professor at the University of Denver in Denver, CO.
chris.hughen@du.edu

Jack Strauss
is the Miller Chair of Applied Economics at the University of Denver in Denver, CO.
jack.strauss@du.edu

While the price-to-earnings ratio (P/E) is arguably the most popular tool for equity valuation, recent studies support the ability of other fundamental ratios to predict the cross section of returns. Novy-Marx [2013] finds that gross profit performs as well as the book-to-market ratio. Ball et al. [2015] demonstrate that operating profit is more strongly linked to expected returns than gross profit or net income. Fama and French [2015] develop a five-factor model that includes operating profit as an important factor in explaining the cross section of stock returns, and several prominent firms have recently incorporated this metric in their investment strategies.[1] Loughran and Wellman [2011] further find that the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to enterprise value, which is widely used by practitioners, is a significant determinant of stock returns and a proxy for the discount rate. Gray and Vogel [2012] also confirm EBITDA outperforms traditional metrics.

Although this research highlights the importance of these profitability metrics for explaining the cross section of returns, these studies do not focus on whether these ratios can add value in sector-level portfolio allocations. This is despite modern portfolio management that emphasizes sector exposure in conducting risk analyses and performance attributions.[2] Portfolio managers employing a top-down approach usually start the investment process by developing a target sector allocation. Bunn and Shiller [2014] analyze the performance of sector returns over about 140 years and find "major sectors of the stock market show frequent mispricings that can be exploited" [2014, p. 60]. They develop a normalized cyclically adjusted P/E (CAPE) that can be used in sector rotation to outperform the S&P 500 Index by 4% annually. We extend this research by examining additional ratios and investigating whether out-of-sample forecasts of these variables can enhance the performance of sector-level portfolio allocations and whether profitability ratios effectively identify undervalued stocks within sectors.

In the academic literature, the importance of asset allocation in explaining portfolio returns is unresolved. Barberis and Shleifer [2003] provide a model that motivates sector investing. Brinson, Hood, and Beebower [1986], Brinson, Singer, and Beebower [1991], and Vardharaj and Fabozzi [2007] find that asset allocation explains a substantial portion (70%–90%) of the

time-series variation in total returns for the average fund. Ibbotson and Kaplan [2000] and Xiong et al. [2010] also support the central role of asset allocation but dispute the magnitudes described in previous work by emphasizing that results are sensitive to whether the analysis is time-series or cross sectional.

Although the focus of these studies is the attribution of portfolio returns to various contemporaneous components, our analysis examines whether profitability measures can exploit both sector and firm fundamentals to generate outperforming portfolio allocations in "real time." Successful forecasting models of returns are often "elusive" as investors influence equity returns when exploiting ephemeral opportunities for predictability (Timmermann [2008]). For instance, Welch and Goyal [2008] provide a comprehensive evaluation of 16 prominent financial and macroeconomic variables and show the traditional predictive regression model for forecasting market returns is unstable and has poor out-of-sample performance. Therefore, our approach to analyzing the relation between fundamental ratios and stock returns is different. We choose portfolio allocations based on forecasts of sector fundamentals and past firm fundamentals and do not rely on elusive predictive regressions of returns.

In this article, we propose a portfolio allocation strategy based on sector and firm profitability metrics. These measures—which use items above net income on the income statement—include gross profit, operating profit, EBITDA, and a composite average of all three variables. Our article extends the work of Novy-Marx [2013] and Ball et al. [2015] by relating the performance of these metrics to the characteristics of high-quality earnings (Dichev et al. [2013, 2016]). We assess whether these measures of profitability (above net income) can construct real-time sector and firm-level portfolios that provide returns consistently greater than the buy-and-hold benchmark. The article then explores the relationship between fundamentals and subsequent returns by examining portfolio returns, payoffs, Sharpe ratios, information ratios, and performance over time. Our analysis also evaluates the portfolio performance relative to more traditional fundamentals including cash flows, net income, and book-to-market ratios.

The results show that fundamentals, particularly profitability metrics, provide economically sizable boosts in portfolio performance. The firm and sector allocation method using EBITDA or the composite variable forms portfolios with Sharpe ratios that are 50% greater than the buy-and-hold benchmark, Fama–French three-factor alphas of approximately 14%, and information ratios that exceed 0.70 over 35 years; hence, the allocation strategies produce substantial improvements in performance relative to a passively managed portfolio. Moreover, this allocation approach generates returns greater than the benchmark approximately two-thirds of the time and consistently beats the benchmark over each of the last three decades.

We then examine the source of this superior performance by evaluating portfolio allocations using either sector or firm fundamentals. Although both approaches provide payoffs substantially higher than the benchmark, strategies that select firms within sectors offer substantially larger payoffs than strategies that select sectors. Interestingly, the fundamental ratio that provides the highest payoff for sector allocations is not the ratio that provides the best returns for selecting firms within a sector. Strategies using EBITDA are the most profitable for out-of-sample sector allocations, but strategies using gross profit and the composite variable provide the highest payoffs for firm selection within sectors.

Why do profitability metrics, which use an earnings measure above net income, *work*? In a comprehensive survey of CFOs, Dichev et al. [2013] rank attributes of "high quality earnings." They find that the most cited characteristic of high-quality earnings (in Exhibit 3 of their study) is that they are sustainable (i.e., persistent, recurring, and repeatable) and possess predictive value with respect to future cash flows. These accounting metrics are closer on the income statement to revenue (which is relatively stable) and less likely to be manipulated.[3] The persistence of these profitability measures thus implies they are easier to forecast than net income in real time using an autoregressive model. Our study finds that profitability measures such as gross profit and EBITDA possess out-of-sample R^2 statistics of approximately 75%, and the composite measure has an out-of-sample R^2 of 89%, compared to near zero for the P/E.

Dichev et al. find that the second most frequently mentioned characteristic of high-quality earnings is that they are "free from special or one-time items" [2013, p. 11]. Such earnings are uncontaminated from the items that make them unsustainable, such as nonreoccurring gains/losses. Profitability measures, which provide the best performing sector and firm allocations, are less likely to be affected by these items, which also

contributes to their high out-of-sample predictability. At the same time, earnings are more likely to be affected by one-time charges and large nonreoccurring movements, and this explains their low predictability.

CFOs also posit that high-quality earnings are backed by cash flows. Our results document that profitability metrics, such as gross profit and EBITDA, forecast cash flows better than net income or even cash flows. Because innovations to gross profit or EBITDA are more recurring and persistent than net income, they provide a stronger signal of future cash flows and should be more strongly linked to future equity returns than net income. Additionally, Dichev et al. report that the most important application of earnings is "for use by investors in valuing the company" [2013, p. 10]; hence, a good metric of a firm's performance should be linked to future returns. Our study demonstrates that profitability metrics have a stronger association to future sector and firm returns than net income. Thus, profitability metrics possess the salient characteristics of high-quality earnings or core earnings: sustainability, lower sensitivity to one-time items, and a strong relation to both future cash flows and returns.

ACCOUNTING DATA AND STOCK PRICES

Profitability ratios that use earnings measures above net income on the income statement have recently gained attention as significant factors in explaining returns. Novy-Marx [2013] finds that profitable firms, measured by revenues minus cost of goods sold, generate significantly higher returns than unprofitable firms, despite possessing higher valuation ratios. He posits that this measure is less manipulated than measures that are lower down the income statement and is therefore a "cleaner" measure of economic profitability. However, Ball et al. [2015] reveal that Novy-Marx's interpretation is difficult to reconcile with the data. They argue that gross profit is not a superior measure to net income when these measures are scaled consistently and demonstrate that operating profit, which is gross profit minus selling, general, and administrative (SG&A) expenses but not R&D expenditures, provides a far stronger link with expected returns than either net income or gross profit.

Other researchers document the value of a different approach to deflating profitability. Loughran and Wellman [2011] examine the ratio of operating income before depreciation to enterprise value and find that this measure is significant in a four-factor model. Equity analysts commonly use this ratio for the relative valuation of individual stocks because it allows for the comparison of companies with different leverage and is unaffected by nonoperating gains/losses and noncash expenses such as depreciation. Gray and Vogel [2012] establish that this ratio outperforms earnings, free cash flow, and book value.

Although many studies have investigated the relationship between fundamental ratios in the cross section of stock returns, recent research explores how these ratios can be applied using a portfolio strategy at the sector level. Bunn and Shiller [2014] construct a 140-year series of sector earnings and returns to demonstrate how a normalized CAPE ratio can identify mispriced sectors. Other studies find that using macroeconomic factors or size and book-to-market to weight sectors can enhance portfolio returns (Conover et al. [2008], Kong et al. [2011], and Chong and Phillips [2015]).

DATA

Our analysis extends these studies by examining whether sector forecasts of fundamental ratios add value in portfolio allocation. Based on the studies described previously, we compute ratios of cash flows (CF), earnings (EP), operating profit (OP), gross profit (GP), and book value (BM) to market value; one exception is EBITDA, which is divided by enterprise value, because of work by Loughran and Wellman [2011] and Gray and Vogel [2012]. The Appendix presents the variable definitions.

We also consider a composite variable (COM) that averages all three profitability metrics. This composite should be less sensitive to the differences in operating and financial leverage across sectors as well as earnings manipulation. Similar to coincident and leading economic indicators, composite variables also have the advantage of containing more information than a single variable and producing more stable forecasts (Huang and Lee [2010]).

The sample consists of the constituents of the S&P 500 Index from the Compustat database. We start with the constituents at the beginning of 1975 and update the constituent list every five years thereafter. Because the S&P 500 Index constituents are large-capitalization stocks, our sample does not suffer from low-liquidity effects, nor are our results driven by smaller, riskier firms. We also consider these stocks because we evaluate long/short strategies, which are easier to implement with

large-cap stocks. Our study examines the 10 sectors in the Global Industry Classification System (GICS), which is commonly used by practitioners to analyze portfolio performance and was jointly developed by Standard & Poor's and MSCI. Our analysis at the firm level examines 57,122 observations from 1979.3–2014.4, and the sector analysis uses 400 observations from 1975.1–2014.4. We use return and accounting data from Compustat to analyze the performance of portfolio allocations based on quarterly financial statements.

MODEL

Our sector analysis computes out-of-sample forecasts using a traditional autoregressive (AR) framework:

$$X^{F}_{i,t+1} = a_i + \sum_{j=0}^{n} b_i X_{i,t-j} + e_{i,t+1}, \quad (1)$$

where a maximum of six lags, j, is chosen each quarter by the Akaike Information Criterion. $X_{i,t}$ is the fundamental ratio for sector i in period t. The total sample is divided into an initial in-sample training period from 1975.1 to 1979.3 and an out-of-sample period from 1980.1 to 2014.4. We construct recursive simulated out-of-sample forecasts of the next quarter's ratio at time t. The coefficient estimates are updated each period to obtain 140 forecasts ($X^{F}_{i,t+1}$) of the sector ratios.

To allow for a lag in data release, we forecast sector selections for a given quarter and then compute portfolio performance using returns an additional quarter later. For example, consider portfolio allocations for 1980.1. Using financial data with a filing period ending date prior to 1979.4, we forecast the fundamental ratios using data until 1979.3 and use these forecasts to determine the sector rankings. The performance of these selections is determined using return data for 1980.1, which allows for an extra quarter to accommodate for data release.

The next section describes the profitability of portfolio allocations using both firm and sector fundamentals. We then decompose the results by analyzing a firm-neutral strategy that selects sectors and a sector-neutral strategy that selects firms.

EMPIRICAL ANALYSIS

Our analysis examines the returns and fundamental ratios for each sector. The average quarterly returns from 1975.1 to 2014.4 range from 1.6% for the materials and telecommunications sectors to 2.6% for the consumer staples sector. The information technology sector has the highest return volatility, while returns from the utilities sector have the lowest standard deviation, which is perhaps due to its high degree of regulation. Because our study involves developing portfolio allocations based on forecasts of sector ratios, the autoregressive coefficients are important—they are a measure of persistence or degree of sustainability. Dichev et al. [2016] find that the "essence of earnings quality" is "sustainable and repeatable" results. GP has an average AR4 coefficient of 0.64, which is the highest among the ratios based on income statement data. EBITDA, excluding data for the financial sector, has an average AR4 coefficient of 0.69. These metrics are more persistent than EP, which has an average AR4 coefficient of less than 0.51 and has more transitory components because of a low position on the income statement.

PORTFOLIO ALLOCATION BY FIRM AND SECTOR RATIOS

Exhibit 1 examines portfolio allocation strategies that select both firms and sectors based on fundamental ratios. We compare the performance of portfolio allocations to the returns on a buy-and-hold benchmark, which is a portfolio of the S&P 500 Index constituents with equal sector weights. A $100 investment in this benchmark from 1980.1–2014.4 provides a payoff of $7,017. This portfolio has an average quarterly return of 3.3% and a Sharpe ratio of 0.59. In comparison, the value-weighted S&P 500 Index has an average quarterly return of 3.2%, a payoff of $5,455, and a Sharpe ratio of 0.52, and it is 98.5% correlated with the buy-and-hold benchmark.

Panel A of Exhibit 1 describes the performance of long portfolios that are formed using forecasts of each ratio. The portfolio invests only in the highest-forecasted 20% of sectors and selects the firms within those sectors that are in the top quintile of the sector's valuation. Results reveal that all metrics (except BM) generate returns that are more than 5% p.a. above the benchmark. OP and GP deliver substantially larger performance measured by average quarterly returns, Sharpe ratios, portfolio payoffs, and alphas.[4] For instance, OP and GP provide payoffs of $91,777 and $87,369, respectively; these payoffs are more than twice the payoff from

EXHIBIT 1
Portfolio Allocation by Firm and Sector Ratios

	CF	EP	EBITDA	OP	GP	BM	COM
Panel A: Portfolio of Firms and Sectors in the Top Quintile							
Avg Ret	4.9%	4.8%	4.9%	5.6%	5.7%	3.5%	5.2%
Sharpe	0.69	0.78	0.69	0.81	0.73	0.46	0.76
Payoff	$40,236	$40,758	$40,066	$91,777	$87,369	$6,348	$59,798
Alpha	5.4%	5.4%	5.8%	7.8%	7.6%	2.2%	6.2%
Info ratio	0.42	0.16	0.16	0.55	0.59	0.19	0.39
t-stat	2.51	0.91	0.95	3.22	3.47	–1.15	2.31
Panel B: Portfolio of Firms and Sectors in the Bottom Quintile							
Avg Ret	3.2%	4.8%	2.0%	3.3%	3.3%	4.1%	1.7%
Sharpe	0.37	0.45	0.13	0.42	0.35	0.44	0.11
Payoff	$3,861	$13,667	$457	$4,744	$3,680	$13,748	$504
Alpha	–1.5%	1.5%	–4.3%	0.4%	–0.1%	2.3%	–2.2%
Info ratio	–0.32	–0.76	–0.61	–0.20	–0.26	–0.84	–0.54
t-stat	–1.91	–4.51	–3.63	–1.2	–0.25	4.99	–3.17
Panel C: Portfolio Implementing Long/Short Strategy							
Avg Ret	6.4%	5.1%	7.3%	6.3%	7.1%	4.1%	7.6%
Sharpe	0.79	0.67	0.91	0.78	0.81	0.42	0.95
Payoff	$211,629	$38,981	$688,781	$181,837	$414,981	$7,717	$989,418
Alpha	10.8%	7.8%	12.9%	12.3%	11.5%	1.0%	13.0%
Info ratio	0.65	0.31	0.71	0.60	0.79	0.16	0.75
t-stat	3.83	1.96	4.19	3.51	4.65	0.94	4.41
Panel D: Performance Consistency of Long/Short Strategy							
1980–2014	62.1%	63.6%	71.4%	69.3%	67.1%	62.1%	64.3%
1980s	64.1%	69.2%	79.5%	74.4%	71.8%	61.5%	75.0%
1990s	60.0%	55.0%	60.0%	65.0%	60.0%	55.0%	52.5%
2000s	62.3%	65.6%	73.8%	68.9%	68.9%	67.2%	65.0%
2007.4–14.4	69.0%	62.1%	82.8%	69.0%	62.1%	69.0%	62.1%

Notes: Exhibit 1 presents the portfolio performance from allocations based on forecasted sector and past firm fundamentals. Avg Ret is the average quarterly return. The Sharpe ratio is annualized. Payoff is the dollar value of the portfolio at the end of 2014 that is generated from a $100 investment in 1980. Alpha is the Fama–French three-factor alpha. Info ratio is the annualized information ratio, and t-stat is its corresponding t-statistic. The performance consistency is the percentage of quarterly portfolio returns that exceed the buy-and-hold benchmark return.

the popular EP ratio and more than 12 times the payoff from the buy-and-hold-benchmark. Allocations based on forecasts of OP and GP generate per annum returns that are 8.8% and 9.2% greater than the benchmark, with Sharpe ratios of 0.81 and 0.73, which are 37% and 24% greater than the benchmark, respectively.

Panel B shows results from a short strategy that identifies sectors and firms within those sectors that are in the bottom quintile of valuation. Realized low average returns, payoffs, and alphas indicate a strong link between weak fundamentals and low subsequent returns. EBITDA and COM are particularly successful in identifying poorly performing stocks, as shown by the payoffs from the portfolio allocations based on these ratios of $457 and $504, respectively.

A comparison of Panels A and B shows large performance differences between portfolios composed of the top quintiles of valuation and portfolios composed of the bottom quintiles. For example, allocations formed using EBITDA and COM ratios have average quarterly return differences of 2.9% and 3.5%, respectively. This suggests that a long/short strategy will be successful.

Panel C describes a 150/50 strategy that selects both sectors and firms based on fundamental ratios.[5] This strategy overweights (underweights) sectors in the top (bottom) quintile of forecasted sector ratios

and invests in stocks within these sectors that are in the top (bottom) quintile of past fundamental ratios. The remaining six sectors are equally weighted. Within these sectors, the portfolio implements a 150/50 strategy by purchasing stocks in the highest quintile of valuation and shorting stocks in the lowest quintile of valuation. Long/short strategies using EBITDA and COM have Sharpe ratios of 0.91 and 0.95, payoffs of $688,781 and $989,418, and alphas of 12.9% and 13.0%, respectively. The information ratios for GP and COM are at least 0.75 over 35 years and support the use of profitability metrics in generating allocations that produce significant improvements in performance. Goodwin [1998] finds that few active managers maintain information ratios of 0.5 or higher over a ten-year period.

Lastly, Panel D investigates the robustness of the results by reporting the percentage of times the portfolio generates returns greater than the buy-and-hold benchmark over the sample period and subsamples, as consistency of performance is a relevant concern for investors. The panel presents these percentages for the entire sample—three decades (1980s, 1990s, and 2000s), as well as during the financial crisis and its aftermath (2007.4–2014.4). The long/short strategy particularly generates returns that consistently outperform the market. The profitability measures (EBITDA, OP, and GP) outperform the benchmark in the majority of quarters in each of the four subperiods and over two-thirds of the 140 quarters. These statistics are remarkable given the difficulty of beating a buy-and-hold strategy reliably over each decade. The top and bottom quintiles of profitability measures generate allocations that consistently outperform the benchmark over 140 quarters and different sample periods.

We also examine robustness by plotting the performance of the portfolios relative to the returns of the S&P 500 Index.[6] Exhibit 2, Panels A and B, illustrates the consistency of the allocation strategies described in Exhibit 1, Panels A and B, by graphing the cumulative payoffs of the portfolio strategies minus the cumulative payoffs of the index. These plots are similar in spirit to those of Welch and Goyal [2008]; however, our figures represent the difference in cumulative payoffs, not the difference in cumulative excess return predictability. The portfolio for each metric begins with $100 in 1980.1. The portfolio return minus the index return is accumulated each quarter to indicate whether the portfolio allocation produces a higher payoff than the S&P 500 Index for any particular out-of-sample period. A steady upward-sloping line indicates that the portfolio allocation regularly outperforms the S&P 500 Index.

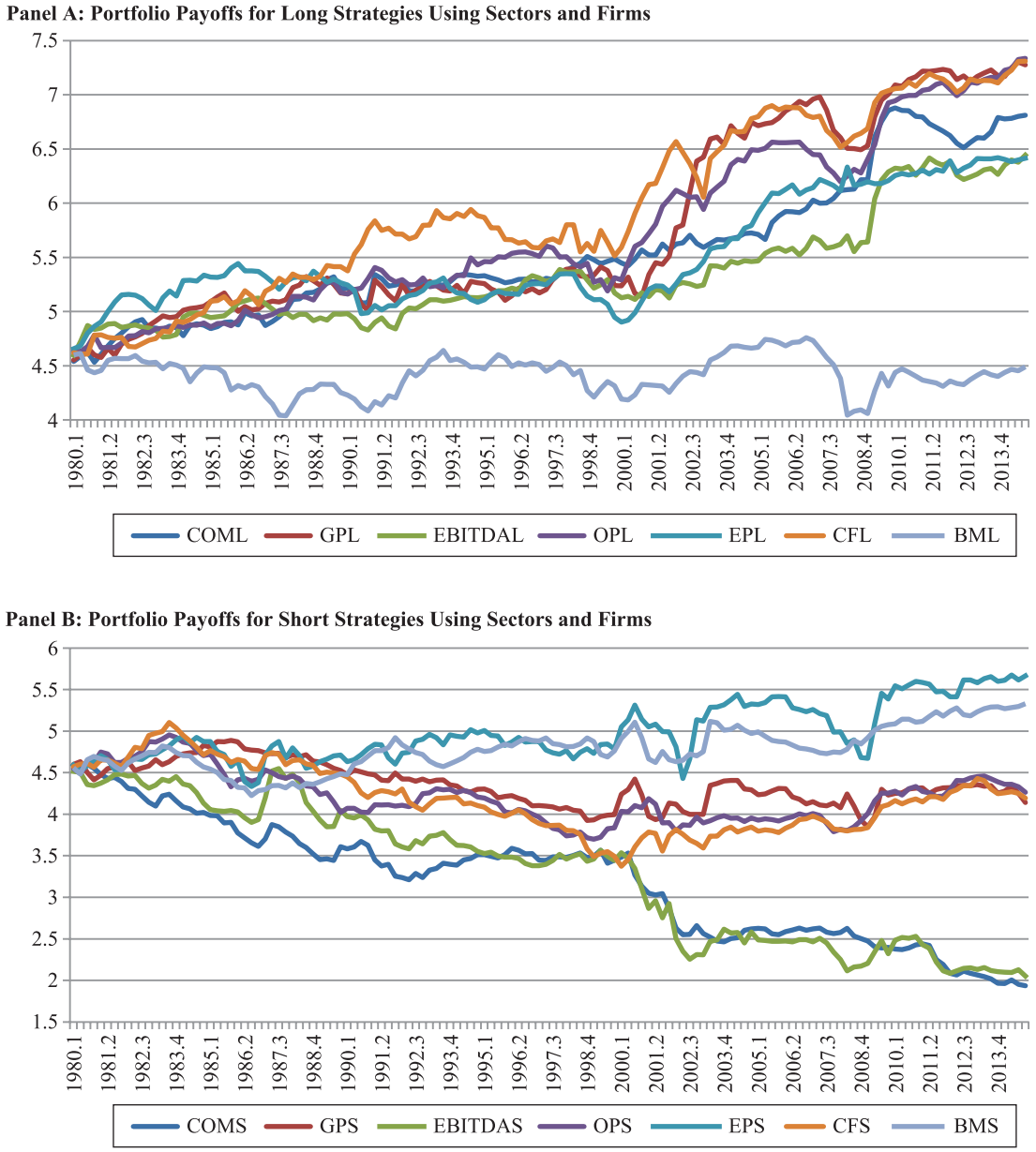
PORTFOLIO ALLOCATION BY SECTOR RATIOS

This section examines whether prior results are driven primarily by allocations at the firm or sector level. We begin our investigation by forming portfolios using out-of-sample sector forecasts while maintaining the same firm exposure within each sector as the benchmark.[7] Panel A of Exhibit 3 describes these portfolios, which take long positions in the sectors in the top quintile of forecasted sector fundamentals. Sector forecasts based on EBITDA, GP, and COM ratios provide superior performance relative to the buy-and-hold benchmark. In other words, high forecasted sector fundamentals are positively related to future returns. For example, sector allocations formed using EBITDA have average quarterly returns of 4.0%, a payoff of $15,863, and a Sharpe ratio of 0.71.

Panel B of Exhibit 3 shows the portfolio performance from strategies that invest in sectors in the lowest quintile of the forecasted ratios. Sector forecasts of EBITDA, GP, and COM are particularly successful in identifying poor performers. The portfolio based on EBITDA has an alpha of −2.1%, an average return that is 4% p.a. less than the buy-and-hold benchmark, and a payoff 75% less than the benchmark. The lowest quintile of forecasted sector fundamentals thus have a strong link to low returns in those sectors. The large difference in performance between the allocations described in Panels A and B suggest a long/short strategy based on sector fundamentals will be successful.

We examine the performance of a 150/50 strategy that takes short positions of 50% in the two sectors with the lowest forecasted fundamentals and long positions of 150% in the two sectors with the highest-forecasted fundamentals. The results are shown in Panel C. EBITDA again provides the highest payoff, Sharpe ratio, and information ratio for sector allocation. The allocation payoff using this ratio is $38,598—almost 50% higher than the payoff from the second best performing ratio (GP) and over five times the benchmark payoff of $7,017. The annualized return for portfolios using forecasts of EBITDA is 5.6% greater than the benchmark. It generates an alpha of 8.3% and a Sharpe

EXHIBIT 2
Cumulative Portfolio Payoffs Relative to the Index



Notes: We start with a portfolio value of $100. The figure shows the logged payoffs minus the payoff of the S&P 500 Index, 1980.1–2014.4.

ratio of 0.77 (an increase of more than 30%), which signals large risk-adjusted and economically material gains. Overall, the evidence from Exhibit 3, Panels A, B and C, implies that forecasting fundamentals can lead to sector allocations that substantially outperform a buy-and-hold approach. Finally, Panel D shows the consistency of long/short strategy performance. In each subperiod, sector allocations using COM and GP exceed the benchmark returns in a majority of quarters.

An alternative method to sector allocation is to choose sectors based on a predictive regression approach. This method regresses returns on the fundamental ratios and forecasts returns, not fundamentals.[8] Each sector return is regressed on a ratio lagged two quarters

EXHIBIT 3
Portfolio Allocation by Sector Ratios

	CF	EP	EBITDA	OP	GP	BM	COM
Panel A: Portfolio of Sectors in Top Quintile							
Avg Ret	3.5%	3.5%	4.0%	3.9%	4.0%	3.0%	4.0%
Sharpe	0.57	0.59	0.71	0.66	0.68	0.46	0.71
Payoff	$8,095	$8,111	$15,863	$13,006	$14,562	$4,001	$14,852
Alpha	3.8%	2.0%	4.8%	5.6%	4.1%	0.5%	5.3%
Info ratio	0.16	0.14	0.35	0.32	0.35	–0.08	0.08
t-stat	0.94	0.82	2.08	1.88	2.04	–0.49	0.62
Panel B: Portfolio of Sectors in Bottom Quintile							
Avg Ret	3.6%	3.3%	2.4%	3.8%	2.8%	3.5%	2.6%
Sharpe	0.53	0.43	0.30	0.60	0.37	0.57	0.39
Payoff	$8,317	$4,928	$1,767	$10,968	$2,834	$7,912	$2,570
Alpha	1.2%	–0.2%	–2.1%	2.2%	–1.0%	0.8%	0.5%
Info ratio	0.13	0.05	–0.34	0.24	–0.16	0.14	–0.33
t-stat	0.75	0.31	–2.04	1.45	–0.96	0.85	–2.04
Panel C: Portfolio Implementing Long/Short Strategy							
Avg Ret	3.5%	3.6%	4.8%	3.9%	4.5%	4.4%	4.6%
Sharpe	0.46	0.52	0.77	0.54	0.78	0.31	0.72
Payoff	$6,342	$7,583	$38,598	$10,642	$26,093	$2,183	$29,314
Alpha	5.2%	2.8%	8.3%	7.1%	6.7%	–1.1%	8.6%
Info ratio	0.09	0.10	0.44	0.19	0.36	–0.11	0.26
t-stat	0.54	0.61	2.63	1.11	2.14	–0.66	1.65
Panel D: Performance Consistency of Long/Short Strategy							
1980–2014	55.0%	56.4%	55.7%	53.6%	55.0%	42.8%	59.2%
1980s	57.5%	55.0%	57.5%	57.5%	60.0%	45.0%	67.5%
1990s	65.0%	57.5%	45.0%	62.5%	55.0%	40.0%	65.0%
2000s	42.5%	57.5%	70.0%	42.5%	52.5%	47.5%	57.5%
2007.4–14.4	58.6%	51.8%	55.3%	58.6%	52.0%	34.8%	52.3%

Notes: Exhibit 3 presents the portfolio performance from sector allocations based on forecasted fundamental ratios. Avg Ret is the average quarterly return. The Sharpe ratio is annualized. Payoff is the dollar value of the portfolio at the end of 2014 that is generated from a $100 investment in 1980. Alpha is the Fama–French three-factor alpha. Info ratio is the annualized information ratio, and t-stat is its corresponding t-statistic. The performance consistency is the percentage of quarterly portfolio returns that exceed the buy-and-hold benchmark return.

(to allow for data release); the top and bottom forecasted sector quintiles are selected for long and short positions. Although not reported here for conciseness, the results show all long positions generate portfolios with average returns lower than the benchmark and even less than the short positions. We calculate the percentage of quarters that these strategies beat the benchmark. Neither the long nor the short strategies consistently outperform or underperform the benchmark because no percentage is greater than 53%; further, the R^2_{OS} (out-of-sample R^2) statistics for each sector are almost always less than 4% (results available upon request). Overall, the evidence suggests that sector allocation generates superior performance by focusing on forecasting fundamentals, not elusive returns.

Our analysis supports the argument that portfolio allocation across sectors works well when using a ratio that is not sensitive to industry-specific financial characteristics. Results find that EBITDA is the best performing fundamental ratio for sector allocation, and this metric is less sensitive to financial leverage and capital intensity. Both the numerator and denominator of this ratio include adjustments for significant use of leverage. EBITDA does not include a charge for interest, depreciation, or amortization, and enterprise value includes debt.

EXHIBIT 4
Portfolio Allocation by Firm Ratios

	CF	EP	EBITDA	OP	GP	BM	COM
Panel A: Portfolio of Firms in Top Quintile							
Avg Ret	5.1%	4.4%	4.9%	5.0%	5.1%	4.4%	5.0%
Sharpe	0.71	0.73	0.77	0.72	0.74	0.63	0.80
Payoff	$49,460	$24,126	$43,885	$45,204	$53,239	$21,259	$53,180
Alpha	4.6%	3.3%	4.8%	4.1%	4.6%	2.5%	5.3%
Info ratio	0.53	0.58	0.63	0.61	0.64	0.45	0.51
t-stat	3.15	3.43	3.71	3.6	3.8	2.65	2.52
Panel B: Portfolio of Firms in Bottom Quintile							
Avg Ret	3.4%	4.2%	3.1%	3.2%	3.1%	3.9%	3.1%
Sharpe	0.47	0.55	0.41	0.47	0.46	0.60	0.44
Payoff	$5,885	$16,061	$4,025	$5,012	$4,524	$12,542	$4,165
Alpha	0.2%	1.4%	–0.2%	–0.1%	–0.4%	2.0%	–0.4%
Info ratio	0.10	0.37	–0.03	0.01	–0.06	0.34	–0.33
t-stat	0.6	2.21	–0.15	0.07	–0.37	2.04	–0.92
Panel C: Portfolio Implementing Long/Short Strategy							
Avg Ret	5.8%	4.4%	5.8%	5.9%	6.2%	4.7%	6.0%
Sharpe	0.72	0.74	0.86	0.77	0.78	0.59	0.89
Payoff	$109,771	$25,977	$126,248	$118,509	$158,248	$23,692	$171,764
Alpha	7.0%	4.2%	6.8%	6.2%	6.8%	3.1%	6.9%
Info ratio	0.53	0.46	0.67	0.65	0.69	0.38	0.67
t-stat	3.15	2.7	3.97	3.82	4.05	2.22	3.25
Panel D: Performance Consistency of Long/Short Strategy							
1980–2014	60.7%	60.0%	66.4%	62.1%	66.4%	56.4%	70.0%
1980s	65.0%	62.5%	67.5%	65.0%	65.0%	62.5%	70.0%
1990s	50.0%	45.0%	55.0%	50.0%	55.0%	42.5%	57.5%
2000s	65.0%	70.0%	70.0%	67.5%	75.0%	60.0%	75.0%
2007.4–14.4	62.2%	62.1%	78.9%	65.5%	68.8%	52.1%	75.7%

Notes: Exhibit 4 presents the portfolio performance from firm allocations based on firm fundamental ratios two quarters previous. Avg Ret is the average quarterly return. The Sharpe ratio is annualized. Payoff is the dollar value of the portfolio at the end of 2014 that is generated from a $100 investment in 1980. Alpha is the Fama–French three-factor alpha. Info ratio is the annualized information ratio, and t-stat is its corresponding t-statistic. The performance consistency is the percentage of quarterly portfolio returns that exceed the buy-and-hold benchmark return.

The extent that financial characteristics vary across industries is controversial. Bowen, Daley, and Huber [1982] find that debt use varies by industry but the rankings of industry debt use are stable over time. However, MacKay and Phillips [2005] find industry effects explain only 13% of financial structure variation and conclude that the majority of the variation occurs within, not across, industries. A cursory look at the ratios for the S&P 500 Index supports the existence of substantial differences across sectors. At the end of our sample period (2014), the ratio of long-term debt to equity has a range of 29.7% to 187.7%, and sectors also have substantial differences in depreciation and amortization. Our results find the best performing ratio for sector allocations is EBITDA, which is less sensitive to industry differences and consistently identifies undervalued and overvalued sectors. This supports the view that fundamentals matter for sector allocations.

PORTFOLIO ALLOCATION BY FIRM RATIOS

We next examine sector-neutral allocations. Exhibit 4 presents the performance of portfolio allocations that select stocks in the S&P 500 Index based on fundamental firm ratios while maintaining an equal sector weighting. Panels A and B describe the

performance of strategies that select firms in the top and bottom quintile of valuation in each sector, and Panel C presents a 150/50 strategy of these selections.[9]

Panel A of Exhibit 4 demonstrates that identifying firms with high EBITDA, GP, and COM leads to strong portfolio performance. For instance, EBITDA has an average quarterly return of 4.9% (6% p.a. higher than the benchmark), a Sharpe ratio of 0.77 (30% greater), a payoff of $43,885 (more than six times greater than the benchmark), an alpha of 4.8%, and an information ratio of 0.63. COM possess an average return of 5.0%, a Sharpe ratio of 0.80, a payoff of $53,180, an alpha of 5.3%, and an information ratio of 0.51. These results support a close relationship between healthy firm fundamentals and strong returns two quarters later.

Panel B of Exhibit 4 shows that stocks with low profitability ratios have relatively low subsequent returns and should be selected to short. EBITDA and COM identify firms with average returns of 3.1% (approximately 1% p.a. less than the benchmark) and payoffs of approximately 40% less than benchmark. The evidence therefore supports a strong link between weak firm fundamentals and subsequent weak firm returns two quarters later.

The long/short strategy in Panel C shows that GP has an average quarterly return of 6.2%, a payoff of $158,248, and an alpha of 6.8%, while COM has an average quarterly return of 6.0%, a payoff of $171,764, and an alpha of 6.9%. For these ratios, the payoffs from stocks in the top quintile are 12 times the payoffs from those in the bottom quintile. Further, the Sharpe ratios for all four metrics using an earnings measure above net income, EBITDA, OP, GP and COM are 0.86, 0.77, 0.78, and 0.89. These represent large risk-adjusted gains; for example, portfolios formed using COM have a Sharpe ratio 50% greater than the buy-and-hold benchmark. All four profitability metrics considerably outperform the more popular ratios of EP and BM. The information ratios for these four profitability measures are over 0.60, which indicates substantial gains relative to the benchmark. Thus, results support a strong predictive relationship between profitability ratios and future stock returns. Panel D shows that strategies using these ratios consistently outperform the benchmark in a majority of the quarters.

Comparison between Exhibits 3 and 4 clearly show that portfolio allocations at the firm level using the profitability metrics produce long payoffs that are approximately three to six times the payoffs from strategies applied only at the sector level. For example, Exhibit 3, Panel A, shows a long strategy payoff from using EBITDA for sector allocations of $15,863, while the payoff at the firm level is $43,885 (Exhibit 4, Panel A). Results for GP at the firm level reveal a payoff of $53,239, while a portfolio allocation strategy at the sector level provides a payoff of $14,562. Most importantly, comparing Exhibit 1 to Exhibits 2 and 3 reveals that average returns, Sharpe ratios, payoffs, and information ratios are substantially higher for the combined firm and sector strategy than for a strategy that allocates based on either sector or firm fundamentals alone. For instance, the payoff based on the long/short strategy using COM in Exhibit 1 is nearly six times greater than the firm strategy using COM in Exhibit 4; this is because average returns are 6% greater per year using the combined firm and sector strategy than using a firm-only strategy. Exhibit 1 shows that a strategy based on COM has an alpha of 13.0% and a Sharpe ratio of 0.95, compared to an alpha of 6.9% and a Sharpe ratio of 0.89 using the firm strategy. The substantial boost in Sharpe ratios further indicates that the gains from the combined firm and sector strategies are not driven by more risk exposure. Therefore, combining sector forecasts with firm fundamentals provides material value.

INTERPRETATION OF RESULTS

Why do profitability metrics generate considerably greater portfolio performance than earnings? We investigate whether these variables possess important attributes of high-quality earnings: sustainability and "useful predictors of future cash flows" (Dichev et al. [2016]).[10]

Exhibits 5 and 6 present evidence concerning these characteristics. Exhibit 5 reports R^2_{OS} (out-of-sample R^2) statistics for the ratios. When a variable experiences more repeatable or recurring innovations and fewer large one-time special items, it will have greater out-of-sample predictability. In contrast, if a variable experiences large numbers of transitory innovations or possesses a structural break or instability of its parameters, the R^2_{OS} will be near zero or negative. Results indicate that EBITDA, GP, and COM possess relatively high R^2_{OS} statistics; for example, R^2_{OS} average across sectors 75%–89%, which is considerably greater than the traditional predictive regression model that focuses on forecasting returns. Thus, it is relatively straightforward to forecast profitability metrics as innovations if these

EXHIBIT 5
Out-of-Sample R^2 Statistics by Sector

Sector	CF	EP	EBITDA	OP	GP	BM	COM
ENE	78.4%	44.7%	88.9%	–2.3%	86.8%	94.6%	91.8%
MAT	63.3%	70.3%	62.1%	22.9%	66.1%	96.1%	93.6%
IND	61.8%	–0.2%	61.9%	0.5%	69.6%	93.0%	87.5%
CDIS	59.6%	–36.8%	66.6%	8.7%	65.6%	94.6%	92.4%
CST	57.9%	–360.7%	66.3%	1.8%	69.1%	90.5%	85.2%
HC	62.5%	68.1%	91.4%	–1.5%	79.2%	95.5%	88.0%
FIN	76.9%	44.4%	70.3%	25.4%	77.5%	94.8%	93.8%
IT	75.9%	–87.2%	70.1%	3.7%	79.8%	90.7%	87.8%
TEL	78.6%	87.0%	92.3%	17.0%	86.4%	95.6%	90.2%
UTI	59.7%	8.8%	79.4%	0.8%	67.0%	91.7%	89.3%
Average	67.5%	–16.2%	74.9%	7.7%	74.7%	93.7%	89.4%

Note: Exhibit 5 reports out-of-sample R^2 statistics for the fundamental ratios for the 10 sectors.

variables are persistent or recurring.[11] Their sustainability hence reflects characteristics of high-quality earnings; this means positive innovations are more likely sustained than positive innovations to net income. In four sectors, earnings innovations are less than zero, which is likely due to structural breaks or instability in the parameters. Thus, the high persistence of EBITDA, GP, and COM supports our earlier reported strong relationship between profitability metrics and subsequent returns; this means profitability metrics have sustainable innovations (and fewer one-time special items that are unforecastable), and movements in these variables affect future returns more than innovations to earnings, which contain greater transitory (less persistent) movements.

Are profitability metrics also tied to future cash flows? The top half of Exhibit 6 reports out-of-sample, one-year ahead four-quarter sector forecasts of cash flows. Similar to Equation 1, we use 1975.1–1979.3 as our initial in-sample period and then recursively update the forecasts each quarter. We also allow for an extra quarter data release and hence use data until 1979.3 to forecast cash flows from 1981.1 to 1981.4 (e.g., one-year ahead, four-quarter horizon). We use this framework to simulate a long-horizon model because fundamentals should predict future long-run cash flows. A long strategy of selecting sectors in the highest quintile of forecasted cash flows with lagged cash flows has an average cash flow of nearly 0.07 (or cash-to-assets equal to 7%), which is greater than the average cash flow of 0.052. A short strategy of selecting sectors in the lowest quintile of forecasted cash flows yields a ratio of 0.031. In other words, the short strategy identifies cash flows considerably less than the benchmark and less than half the long sector. These results imply that forecasts of sectors with strong fundamentals are related to sectors with healthy cash flow performance one year later, and forecasts of sectors with weak cash flows are associated with weak cash flows one year later.

We then use the other fundamental ratios to forecast one-year ahead four-quarter horizon cash flows using a distributed lag setup; this implies we use only the lagged fundamental ratio, not lagged cash flows, to forecast future cash flows. Inspection of the sector results for the long position reveals that all four profitability metrics forecasts successfully identify sectors a year ahead with healthy future cash flows, as the ratios are above 0.07. The short strategy shows that EBITDA and GP generate cash flow ratios less than 0.039. We also present the long-minus-short ratios; and the larger the gap, the greater the forecasts distinguish sectors with healthy versus weak cash flow. All four profitability metrics possess relatively large differences in cash flows and imply that these metrics have predictive value—they help identify or predict sectors with strong and weak cash flows in the future.

The bottom half of Exhibit 6 reports firm results. Because the top and bottom quintiles of cash flow firm percentages are relatively close to average cash flows, there is a weak predictive relationship between firms with high (low) current cash flows and high (low) future

EXHIBIT 6
One-Year-Ahead Out-of-Sample Forecasts of Cash

Strategy	CF	EP	EBITDA	OP	GP	BM	COM
Long Sector	0.070	0.068	0.071	0.071	0.071	0.069	0.071
Short Sector	0.031	0.034	0.030	0.031	0.030	0.032	0.032
Long/Short Sector	0.039	0.034	0.041	0.039	0.041	0.037	0.039
Long Firm	0.057	0.047	0.059	0.063	0.088	0.057	0.081
Short Firm	0.052	0.063	0.041	0.038	0.039	0.052	0.038
Long/Short Firm	0.005	–0.016	0.018	0.026	0.049	0.005	0.043

Notes: Exhibit 6 forecasts the one-year-ahead cash flow ratio using the fundamental ratios in each of the seven columns. The report statistics are CF/assets.

cash flows. This implies that it is difficult to use current firm cash flows to predict firm cash flows one year in the future. However, the top quintile of GP and COM (the long strategy) generates ratios above 0.08, indicating that these metrics can relatively accurately identify firms with strong cash flow one year ahead; EBITDA and OP have ratios from 0.059–0.063 and thus are also useful at predicting firms with healthy cash flow one year ahead. The short strategies using OP, GP, and COM can also identify firms with low cash flows a year ahead; these ratios are less than 0.04, implying that these profitability metrics can forecast firms with weak cash flows. The last row indicates that the long-minus-short percentages are greater than 0.04 for GP and COM and greater than 0.02 for OP; hence, these variables successfully distinguish firms with strong-versus-weak cash flows. Overall, the exhibit shows that COM, GP, and EBITDA identify both firms and sectors with strong and weak future cash flows more accurately than CF or EP; thus, these profitability metrics possess attributes of high-quality earnings in that they are useful predictors of cash flows.

Lastly, one of the interesting questions that we examine is whether ratios that are effective in selecting firms within a sector are also effective in selecting sectors. The ratios that we examine vary in their sensitivity to certain financial characteristics. If sectors contain firms with significantly different capital structures, asset types, growth opportunities, and competitive dynamics, then a fundamental ratio that is less sensitive to these factors may function better for sector allocation. On the other hand, the fundamental ratio that effectively reflects a company's economic performance may function equally well within sectors and across sectors. Also, the ability to forecast certain ratios may play a part in their performance.

CONCLUSION

Our study assesses the portfolio performance of three profitability metrics using earnings measures above net income (EBITDA, gross profit, and operating profit) and a composite average of these three variables in real time from 1980.1–2014.4. A strategy that combines out-of-sample sector forecasts and past firm fundamentals of these profitability metrics generates portfolio performance substantially greater than a buy-and-hold benchmark. Long/short portfolios based on EBITDA, gross profit, or a composite metric generate payoffs more than 30 times a buy-and-hold benchmark and alphas between 11.5% and 13.0%. The Sharpe ratios for all three of these profit metrics are 50% higher than for the buy-and-hold or market benchmark. Further, the allocation selections generate returns greater than the buy-and-hold strategy two-thirds of the time over the past 35 years, as well as over the past three decades.

By examining whether these results are driven by allocations at the firm or sector level, we extend the existing research on gross and operating profitability (Novy-Marx [2013], Ball et al. [2015] and Fama and French [2015]). We show that a portfolio strategy that uses both sector and firm allocations considerably outperforms a strategy using either firm or sector allocations alone. Additionally, EBITDA, which is less sensitive to differences in operating and financial leverage, provides the most profitable sector allocations while gross profits and the composite metric produce the highest returns for selecting firms within sectors.

Lastly, this article provides an explanation for the superior performance of profitability metrics. Results document that EBITDA, gross profit, and the composite variable possess the characteristics of high-quality

earnings (Dichev et al. [2013, 2016]). The profitability metrics are more persistent than earnings and forecast future cash flows more accurately than earnings. Increases in EBITDA, gross profit, and the composite variable hence signal strong firm and sector fundamentals that are likely to persist, lead to higher future cash flows, and generate higher subsequent stock returns. As a result, profitability metrics can be used to form portfolio allocations at the firm and sector level that strongly outperform relevant benchmarks.

APPENDIX

Ratio Definitions

We examine the following ratios, which are defined using their Compustat variable names:

Earnings-to-Market-Value Ratio (EP)
= IBQ/MV where
IBQ is income before extraordinary items and
MV is the end of quarter market value of equity.

Book-to-Market Ratio (BM)
= SEQQ/MV where
SEQQ is the quarterly shareholders equity – total.

Cash-Flow-to-Marke-Value Ratio (CF)
= (OIADPQ – ACCRUAL)/MV where
OIADPQ is the quarterly operating income after depreciation,

ACCRUAL = Δ(ACTQ – CHEQ) – Δ(LCTQ – DLCQ – TXPQ) – DPQ
= the change in noncash current assets minus the change in current liabilities excluding short-term debt and taxes payable.
ACTQ is quarterly total current assets.
CHEQ is quarterly cash and short-term investments.
LCTQ is quarterly total current liabilities.
DLCQ is quarterly debt in current liabilities.
TXPQ is quarterly income taxes payable.
DPQ is quarterly total depreciation and amortization.

EBITDA/EV (EBITDA)
= OIBDPQ/(MV + DLCQ + DLTTQ + PSTKRV – CHEQ) where
OIBDPQ is quarterly operating income before depreciation.
DLTTQ is quarterly long-term debt.
PSTKRV is the annual redemption value of preferred stock.

Operating Profit (OP)
= (REVTQ – COGSQ – XSGAQ + XRDQ)/MV where
REVTQ is the quarterly total revenue.
COGSQ is the quarterly cost of goods sold.
XSGAQ is quarterly selling, general and administrative expenses.
XRDQ is quarterly research and development expense.

Gross Profit (GP)
= (REVTQ – COGSQ)/MV.

ENDNOTES

[1]Dimensional Fund Advisors, for which Fama is a founding member of the Board of Directors, and AQR Capital Management have developed equity funds that incorporate operating profit in their stock screening process.

[2]The most popular approach to performance attribution for equity portfolios focuses on sectors. This approach, frequently called the *Brinson model* (Brinson, Hood, Beebower [1986]), decomposes portfolio returns into sector selection and stock selection components. To support such analysis, Standard & Poor's and MSCI developed a classification system in 1999 that assigns stocks to sectors, and Dow Jones and FTSE created a competing system in 2004.

[3]Dichev et al. [2013, 2016] document that earnings manipulation is common, frequently material, and includes positive and negative misrepresentations.

[4]We also tested a five-factor model; the alphas do not materially change because the estimates for the four- and five-factor models are relatively small and in most cases insignificant.

[5]A 150/50 strategy takes short positions worth 50% of the portfolio value and uses the proceeds from the shorts to fund long positions worth 150% of the portfolio value. Because GICS has 10 sectors, short positions are taken in the two sectors in the bottom quintile of valuation, so the sectors each have weights of –25%. This funds overweighting the sectors in the top quintile of valuation, and these two sectors have weights of 37.5%. The remaining six sectors are equally weighted with each comprising 12.5% of the portfolio.

[6]Our study documents performance relative to the buy-and-hold benchmark and presents these results in tables like that shown in Exhibit 1. We further demonstrate outperformance compared to the S&P 500 Index and display this performance in the graphed exhibits.

[7]An alternative approach to forecasting sectors uses the latest ratio available for sector i, which is period $t - 2$. Using the past actual ratio leads to lower performance than the forecasting distributed lag; for example, for the portfolios

described in Exhibit 3, Panel A, the return and payoff is higher when using the forecasts for six out of the seven ratios, and the payoff is greater by an average of $2,900.

[8]Welch and Goyal [2008] highlight the importance of the out-of-sample forecasting approach using the traditional predictive regression approach as well as provide an excellent review of the prior literature. On the industry level, Kong et al. [2011] use the out-of-sample approach to evaluate the importance of size and book-to-market; and Lallemand and Strauss [2016] highlight the importance of combining accounting variables to forecast industry returns out of sample.

[9]We also considered using the past year of data on the fundamental ratios, $t-2$ to $t-5$, instead of only one quarter of results. Overall, results decline using a full year of data.

[10]Dichev et al. [2013, p. 11] find that CFOs associate quality earnings with the following phrases: "repeatable, recurring, consistent, reflecting long-term trends, and/or have the highest chance of being repeated in future periods." We consider these to be the attributes of sustainable earnings.

[11]This persistence is considerably higher than R^2_{OS} statistics for predictive regressions of returns. Similar to the findings of Welch and Goyal [2008], the fundamental ratios typically possess R^2_{OS} from 0%–3% but are not reported for conciseness.

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