

Free Cash Flow and Returns

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Introduction

Free cash flow - or the amount of cash a company generates after accounting for the cash outflows needed to maintain or expand its asset base - is generally seen as a hallmark for a successful company, with value investor William Thorndike commenting “cash flow, not reported earnings, is what determines long-term value.” Free cash flow (from here on denoted FCF) allows management to reinvest in their business, reduce debt, pay dividends, or establish share buybacks, green flags for investors. In this report, I seek to establish whether there is an association between free cash flow growth and equity returns shortly following, over various time horizons. I also hope to explore whether this effect is strengthened by whether this growth comes from the top or bottom line (such as sales growth or cost cutting), whether the company has reported quality earnings (as opposed to manipulated figures), and whether the company has improved its liquidity position, or its ability to meet short-term and long-term obligations. I will also explore whether these effects vary across different industries.

The data used is sourced from a combination of Bloomberg, Compustat Fundamentals Quarterly (via Wharton Research) and Yahoo Finance (processed in Python for previous projects). The data includes the following variables:

- (*revenue_growth*): Q/Q growth in sales/revenue, used to gauge top-line improvements (achieved by selling more product, gaining customers, etc.) and calculated by using a standard percent change formula (left in decimal form).
- (*fcf_growth*): Q/Q growth in free cash flow
- (*niq_growth*): Q/Q growth in net income, used to gauge bottom-line improvements (improvement in net income holding revenue constant is achieved through efficiencies, diminishing labor/input costs, etc.)
- (*current_ratio_change*): Q/Q growth in current ratio, indicating the company’s ability to meet its short term obligations
- (*NEXT_1DAY/NEXT_5DAY/NEXT_10DAY*): Returns achieved in the next 1, 5, and 10 days following rdq (quarter reporting date)

- (*bTicker/cusip*): Two methods of identifying companies
- (*rdq*): Reporting date for the quarter, or the reasonable date that investors received financial information which would influence subsequent returns
- (*Industry*): Company industry as per GICS standards

This data set consists of quarterly observations of companies, with each row representing a quarterly financial report made by a company.

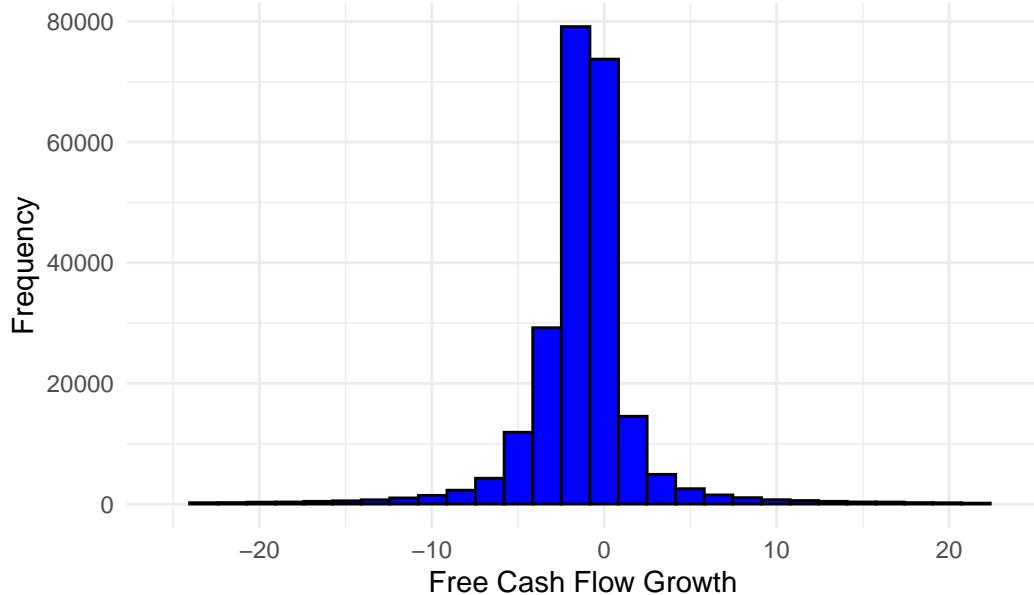
Hypotheses

The author expects that free cash flow growth will correspond with higher returns, particularly in the short term. Growth driven by revenue—indicative of strategic expansion—is likely to have a more substantial impact on returns than that driven by net income increases, when FCF growth is held steady. Furthermore, companies enhancing their liquidity and maintaining high earnings quality—evidenced by strong cash flow relative to net income—are also anticipated to yield better returns, given these traits reflect prudent management and sound financial practices. Finally, I hypothesize that the beneficial effects of robust FCF are largely consistent across different industries.

Initial Observations and EDA

In my initial analysis, I explore the distribution of FCF growth, focusing on eliminating extreme values caused by zeros, minimal prior-period FCF, and accounting irregularities. By bounding my histogram by the 1st and 99th percentiles, the data reveals a tendency for companies to experience declines in FCF rather than gains. This observation aligns with expectations, as achieving growth in FCF typically reflects effective management, a quality less commonly observed than inefficiency.

Distribution of Free Cash Flow Growth



I viewed the distribution of the other variables using histograms and coverage plots for NA values, but for the purpose of concision, I have included five number summaries for each of the dataset columns.

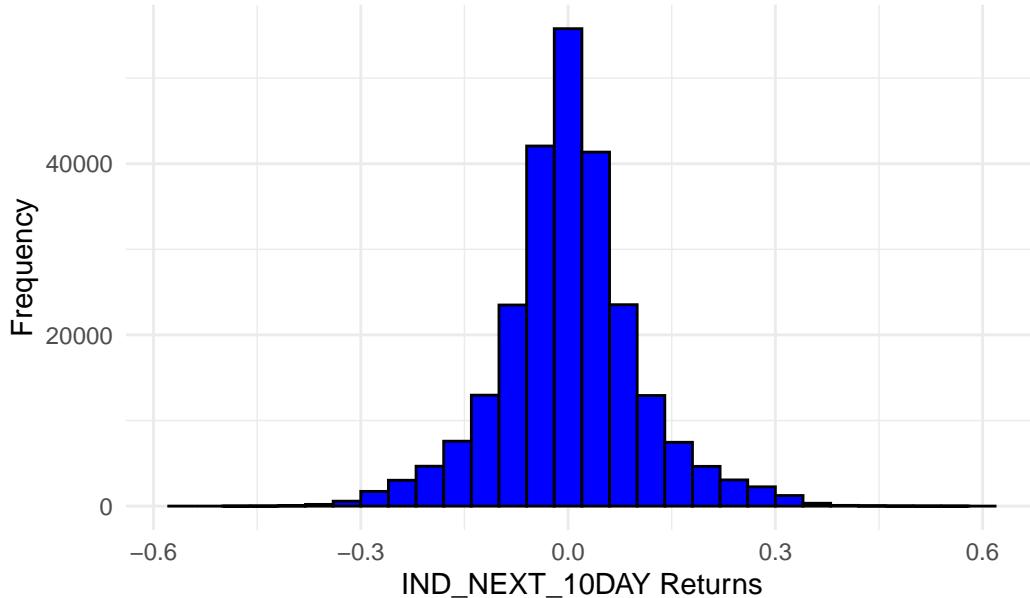
<code>fcf_growth</code>	<code>niq_growth</code>	<code>current_ratio_change</code>
Min. : -2.44e+17	Min. : -11935.000	Min. : -0.98
1st Qu.: -2.00e+00	1st Qu.: -0.536	1st Qu.: -0.08
Median : -1.00e+00	Median : -0.040	Median : 0.00
Mean : Inf	Mean : Inf	Mean : Inf
3rd Qu.: 0.00e+00	3rd Qu.: 0.275	3rd Qu.: 0.08
Max. : Inf	Max. : Inf	Max. : Inf
NA's : 10673	NA's : 2512	NA's : 58977
<code>quick_ratio_change</code>	<code>earnings_quality</code>	<code>NEXT_1DAY</code>
Min. : -0.98	Min. : -59598.62	Min. : -0.183578
1st Qu.: -0.10	1st Qu.: -1.61	1st Qu.: -0.015765
Median : 0.00	Median : 0.93	Median : 0.000367
Mean : Inf	Mean : Inf	Mean : 0.001093
3rd Qu.: 0.09	3rd Qu.: 2.26	3rd Qu.: 0.017177
Max. : Inf	Max. : Inf	Max. : 0.209487
NA's : 63782	NA's : 6851	
<code>NEXT_5DAY</code>	<code>NEXT_10DAY</code>	
Min. : -0.4208530	Min. : -0.5443078	
1st Qu.: -0.0429523	1st Qu.: -0.0505986	

Median : 0.0000824	Median : 0.0000014
Mean : 0.0008520	Mean : 0.0015686
3rd Qu.: 0.0438574	3rd Qu.: 0.0518386
Max. : 0.4769422	Max. : 0.6157410

Clipping the top and bottom percentile values and removing NaN values caused by Compustat discrepancies/accounting filing issues result in reasonable and interpretable predictor variables. This is done before the models are computed in the methodology section. I note that this limits the interpretation to companies which did not have a previous FCF, revenue, niq, or current ratio of 0 or NA, which result in growth figures of - or + infinity. Given more time, I would construct a new metric which diminishes the impact of small base values leading to high growth rates.

The distribution of returns is also somewhat expected. The data is normally distributed around 0 with strong outperformers and underperformers at the tails (more extreme and rare events lead to more volatility in stock price).

Histogram of Next 10 Day Returns



Methodology and Assumptions

This study employs linear and multiple regression analyses to address the research questions concerning the relationship between free cash flow growth and short-term equity re-

turns. The dependent variables in our models are the next-day (NEXT_1DAY), next five-day (NEXT_5DAY), and next ten-day (NEXT_10DAY) equity returns. Each model progressively incorporates additional explanatory variables and controls to isolate the effects of various financial metrics on these returns.

Base Model: Initially, a simple linear regression model was fitted with NEXT_1DAY, NEXT_5DAY, and NEXT_10DAY returns as dependent variables and free cash flow (FCF) growth as the independent variable. This model serves as a baseline to understand the unadjusted effect of FCF growth on equity returns.

Extended Models: To refine our understanding and control for additional financial performance indicators, several extended models were constructed:

- **Top and Bottom Line Growth:** FCF growth was examined while controlling for top-line (revenue growth) and bottom-line (net income growth) improvements. This model assesses whether the impact of FCF growth on returns remains significant when accounting for these broader financial growth metrics.
- **Liquidity Improvement:** Another model incorporated changes in the current ratio to evaluate how improvements in liquidity, alongside FCF growth, are associated with equity returns.
- **Earnings Quality:** FCF growth was also analyzed in conjunction with a measure of earnings quality - measured as the ratio of operating cash flow to net income. This model tests whether the quality of earnings affects the strength of the correlation between FCF growth and subsequent stock returns.
- **Industry Interaction:** Finally, an interaction term between FCF growth and company industry was included to explore whether the effect of FCF growth varies across different sectors.

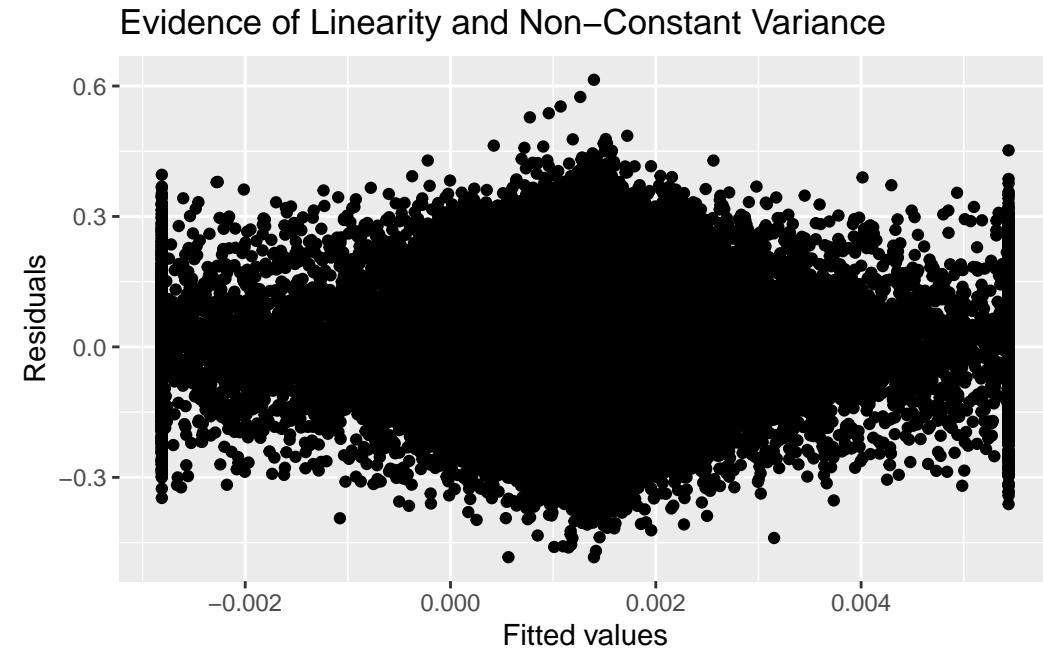
While the data measures information about the same firms over time, which may initially seem to violate the independence assumption due to repeated observations of a single company, the analysis shows a low correlation between the next 1, 5, and 10-day returns after one quarter is reported and the return from the previous quarter. This low correlation suggests that each quarter we are effectively analyzing information about an entirely different company, which has made independent decisions from the previous quarter. If this principle did not hold, simply investing in companies that had previously performed well would be a straightforward and successful strategy.

```
# A tibble: 1 x 3
Cor_1DAY Cor_5DAY Cor_10DAY
<dbl>    <dbl>    <dbl>
1 0.0107   0.0126   0.00940
```

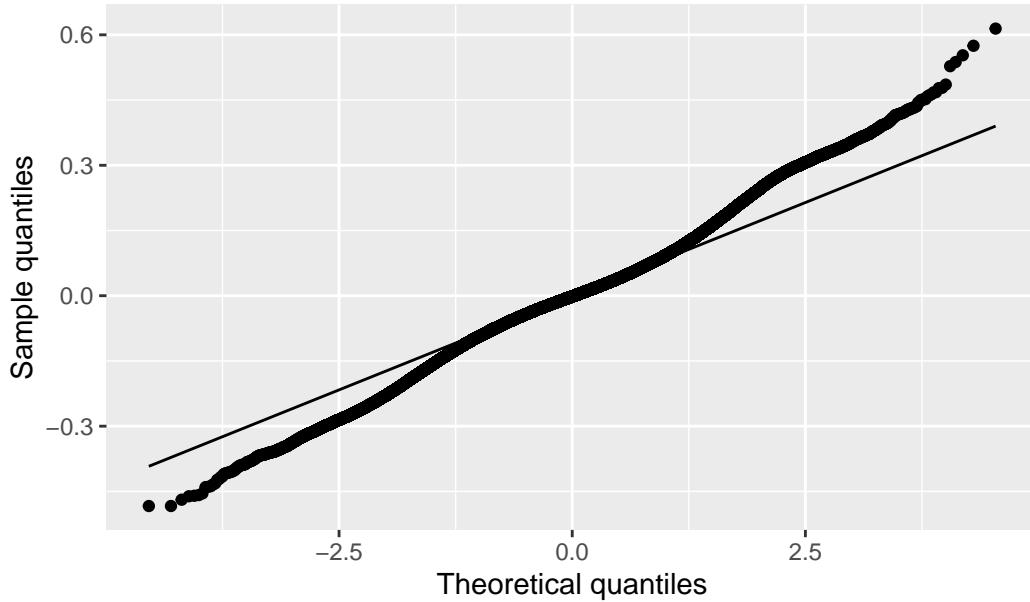
Although this analysis is not sufficient to prove complete independence of observations, it supports the notion that a company reporting their results in one quarter behaves almost like an

entirely different entity in the next quarter, and is evaluated as such by various market participants. This justifies the assumption of independence to a reasonable extent when modeling quarterly returns using linear regression, with the acknowledgment that other dependencies across observations might still exist.

Residual and quantile-quantile plots were utilized to evaluate the assumptions of linearity, constant variance, and normality in our base regression model of returns versus FCF growth. While the assumptions of linearity and constant variance are generally met, the normality assumption is somewhat violated, particularly at the tails of the distribution as evidenced in the Q/Q plot. This suggests that while linear regression is suitable, caution should be exercised regarding the prediction intervals due to potential deviations from normality.



Evidence of non-normality of residuals



While linearity and constant variance are satisfied (the residuals are distributed symmetrically along the horizontal axis with even spread along all fitted values), normality is violated to some degree, as the sample quantiles deviate from the theoretical quantiles at the tails of the Q/Q plot. Even given this violation, it seems reasonable to use a linear regression, with the caveat that the model may result in invalid prediction intervals as a result of the normality assumption being violated. As a note, the presence of vertical lines in the plot of constant variance, indicative of the clipping of predictor variables, is a notable artifact affecting the visual assessment of variance. It's important to acknowledge that this feature is consistent across all regression models utilized in this study, suggesting a systematic influence on our findings.

Results

Base Model

Evidence of Positive Linear Relationship Between FCF Growth and 5 and 10 Day Returns

Forecast Day	Variable	Estimate	Std. Error	Statistic	P-Value
NEXT_1DAY	(Intercept)	0.00125	0.00010	12.91826	0.00000
NEXT_1DAY	fcf_growth	0.00003	0.00002	1.61713	0.10585

NEXT_5DAY	(Intercept)	0.00090	0.00022	4.12874	0.00004
NEXT_5DAY	fcf_growth	0.00018	0.00004	4.36177	0.00001
NEXT_10DAY	(Intercept)	0.00152	0.00026	5.86113	0.00000
NEXT_10DAY	fcf_growth	0.00017	0.00005	3.39628	0.00068

Model Adjusting For Top And Bottom Line

Top Line Growth Shows Significantly Stronger Linear Relationship With Returns than Bottom Line Improvement, Holding FCF Growth Constant

Forecast Day	Variable	Estimate	Std. Error	Statistic	P-Value
NEXT_1DAY	(Intercept)	0.00097	0.00010	9.91886	0.00000
NEXT_1DAY	fcf_growth	0.00002	0.00002	1.31156	0.18967
NEXT_1DAY	revenue_growth	0.00584	0.00035	16.90245	0.00000
NEXT_1DAY	niq_growth	0.00014	0.00003	5.25894	0.00000
NEXT_5DAY	(Intercept)	-0.00021	0.00022	-0.93769	0.34841
NEXT_5DAY	fcf_growth	0.00016	0.00004	3.86413	0.00011
NEXT_5DAY	revenue_growth	0.02290	0.00077	29.64427	0.00000
NEXT_5DAY	niq_growth	0.00033	0.00006	5.47916	0.00000
NEXT_10DAY	(Intercept)	0.00036	0.00026	1.35341	0.17593
NEXT_10DAY	fcf_growth	0.00015	0.00005	2.95741	0.00310
NEXT_10DAY	revenue_growth	0.02423	0.00093	26.13873	0.00000
NEXT_10DAY	niq_growth	0.00032	0.00007	4.45501	0.00001

Model Adjusting for Liquidity Growth

Evidence Of Greater 5 and 10 Day Returns Associated With Improved Liquidity Position, Holding FCF Growth Constant

Forecast Day	Variable	Estimate	Std. Error	Statistic	P-Value
NEXT_1DAY	(Intercept)	0.00124	0.00010	12.82391	0.00000
NEXT_1DAY	fcf_growth	0.00003	0.00002	1.63185	0.10271
NEXT_1DAY	current_ratio_change	0.00049	0.00043	1.12033	0.26257
NEXT_5DAY	(Intercept)	0.00086	0.00022	3.96613	0.00007
NEXT_5DAY	fcf_growth	0.00019	0.00004	4.39453	0.00001
NEXT_5DAY	current_ratio_change	0.00242	0.00097	2.49458	0.01261
NEXT_10DAY	(Intercept)	0.00147	0.00026	5.65832	0.00000
NEXT_10DAY	fcf_growth	0.00017	0.00005	3.43705	0.00059
NEXT_10DAY	current_ratio_change	0.00360	0.00116	3.09028	0.00200

Industry Interaction Term Model

No Statistically Significant Interactions Detected Between Industry Type and FCF Growth in Predicting Returns

Interaction Term	Estimate	Std. Error	Statistic	P-Value
IndustryCommunications:fcf_growth	0.00028	0.00028	0.99524	0.31962
IndustryConsumer, Cyclical:fcf_growth	0.00009	0.00025	0.36367	0.71610
IndustryConsumer, Non-cyclical:fcf_growth	0.00036	0.00025	1.42496	0.15417
IndustryDiversified:fcf_growth	0.00007	0.02590	0.00255	0.99796
IndustryEnergy:fcf_growth	-0.00009	0.00029	-0.31337	0.75400
IndustryFinancial:fcf_growth	0.00040	0.00042	0.95148	0.34136
IndustryGovernment:fcf_growth	0.01142	0.03162	0.36121	0.71794
IndustryIndustrial:fcf_growth	0.00036	0.00026	1.36357	0.17270
IndustryTechnology:fcf_growth	0.00045	0.00027	1.66368	0.09618
IndustryUtilities:fcf_growth	-0.00011	0.00033	-0.32151	0.74782

Model Adjusting for Earnings Quality

Top Line Growth Shows Significantly Stronger Linear Relationship With Returns than Bottom Line Improvement, Holding FCF Growth Constant

Forecast Day	Variable	Estimate	Std. Error	Statistic	P-Value
NEXT_1DAY	(Intercept)	0.00125	0.00010	12.89999	0.00000
NEXT_1DAY	fcf_growth	0.00003	0.00002	1.56552	0.11746
NEXT_1DAY	earnings_quality	0.00001	0.00001	0.76332	0.44527
NEXT_5DAY	(Intercept)	0.00088	0.00022	4.03708	0.00005
NEXT_5DAY	fcf_growth	0.00017	0.00004	4.07039	0.00005
NEXT_5DAY	earnings_quality	0.00009	0.00002	4.46463	0.00001
NEXT_10DAY	(Intercept)	0.00150	0.00026	5.77558	0.00000
NEXT_10DAY	fcf_growth	0.00016	0.00005	3.12673	0.00177
NEXT_10DAY	earnings_quality	0.00010	0.00002	4.14951	0.00003

Discussion

The regression analysis shows that FCF growth has a statistically significant, positive linear relationship with returns in the next 5 and 10 days following the announcement. The beta coefficients are small (this is true across the entire study), which is consistent with other financial studies where effect sizes are often less pronounced due to noisy data. Notably,

the effect does not appear to be statistically significant within the 1-day return period post-reporting. Furthermore, the beta for the 10-day returns is an order of magnitude larger than that for the 5-day returns, suggesting that the impact of FCF growth on returns may grow over time (may take investors time to digest information or could be due to other latent factors).

The study further finds that holding FCF growth constant, there is statistically significant evidence that revenue growth and net income growth have a linear relationship with 1, 5, and 10 day returns. Importantly, the beta coefficient for the revenue growth is significantly larger than that for net income improvement, confirming my hypothesis FCF growth driven by top-line expansion is more strongly correlated with increased returns than bottom line improvements.

Holding FCF growth constant, the study finds that an growth in current ratio and higher earnings quality is associated, on average, with greater 5 and 10 day returns following earnings announcements. However, the earnings quality beta coefficient is orders of magnitude smaller than other variables in this study, and although there is a statistically significant p-value, the practical significance of the metric on returns is negligible relative to others observed.

Finally, the study finds no compelling statistical evidence that there are interaction effects between industry type and FCF growth in influencing returns in the period following earnings announcement (all associated p-values are >0.05). This implies a degree of uniformity across industries when considering how the market values FCF growth.

As mentioned previously in the study, there are several limitations to the above work. The models above violate normality, leading to skewed prediction intervals. The metrics used are also rudimentary, to say the least, and exclude companies which have reported 0 for the variables where growth is measured (as this results in infinite values which were removed). There are also a number of companies with NA values for various variables due to accounting discrepancies, which leads to more data being lost for the model. Economically speaking, there may be reason that an increase from \$0.1 to \$1 should not be considered more significant than an expansion from \$1,000,000 to \$5,000,000, despite growth metrics often suggesting so due to larger percentage increases from smaller bases. In future studies, it would be important to consider new metrics which take this into account - possibly considering a shrinkage factor or change in FCF over total assets to normalize results differently.

The predictive power of the models in this study is inherently low (as expected given the difficult nature of predicting returns). R² values have been excluded as they are close to 0. However, these results can be layered into more sophisticated predictive models, and allow investors to gain a general sense of the relative importance of different metrics.

Future work is promising. There is potential to research whether companies which cross from negative to positive FCF experience greater returns, on average, than companies which go from negative to less negative or positive to more positive. Additionally, a more thorough exploration of revenue growth as a metric is warranted, especially given its robust predictive power for returns in this study. Examining how this relationship has evolved over time could provide further insights into the dynamics at play.