Analyst Forecasts and Stock Prices: The Salient Facts

By

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July 31, 2025

Abstract:

This paper connects stock prices to contemporaneous forecasts of EPS and revenues, one and two years ahead, denoted by (EPS1, EPS2, rev1, rev2). S&P 500 comprises the data, for the years 2003-2021 (19 years), excluding financials and utilities. The analysis centers on the two forward earnings yield measures, EPS1/P and EPS2/P, (or their inverses, the forward PEs), complemented by two distinct growth measures, EPS2/EPS1 and rev2/rev1. The initial benchmark models estimate value based on, first, EPS1 multiplied by the cross-sectional average P/EPS1 multiple, and second, EPS2 and its related multiple. Like Liu, Nissim, Thomas (2002)), the second (EPS2) model results in smaller valuation errors. Neither of the two models can pick up on growth as an attribute affecting valuation. To incorporate growth(EPS) into the valuation, the analysis posits a weighted average of the two benchmarks. This method reduces the valuation errors, but only modestly so. The paper then proceeds to take a closer look at the role of growth in valuation. It examines the power of revenue growth in addition to EPS growth. Though the two growth measures correlate materially, the growth(rev) explains the EPS-yields much better than growth(EPS). It is further shown that stocks with relatively large growth for both measures have large valuation errors compared to other (non-growth) stocks. This "difficult-to-value growth stocks" hypothesis aligns with conventional folklore. It further supports the hypothesis that growth stocks are risky: the key empirical insight verifies that, consistent with theory, stocks with (i) high EPS-yield and (ii) high growth tend to have (iii) high risk. Moreover, for high-risk stocks – but only for such stocks --, measures of growth help to explain prices.

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1. Introduction

Investors expect firms' financial data to bear on current stock prices. They ask a question like "Why does the stock trade at 50 dollars per share?" and demand some kind of answer based on the firm's facial characteristics.[i] As an initial step, investors turn to analyst forecasts (AF) of earnings & revenues because of their well-established role in valuation.[ii] These forecasts are (generally speaking) credible, reinforced by their ubiquitous financial media presence.

Though other AF, such as long-term growth (LTG) and (near-term) forecasted dividends are also systematically provided, EPS and revenues are, by far, the most prominent. These forecasts are frequently revised/updated, but even so, the forecasts can be seriously dated or even missing. Nonetheless, the annual forecasts seem to hold their own, and this paper accordingly limits the forecasts considered to annual EPS and revenues.

Motivated by the practical importance of equity valuation and AF, this paper tries to distill what may be labelled as "salient facts" related to EPS and revenues. Hence, this focus on income statement items derives from a valuation context. It leads to many subtopics that build on each other. To appreciate the flow of ideas and questions addressed, a relatively specific outline helps.

Section 2. The section addresses the hypothesis that the expected EPS1 provides the first-cut indicator of value. To implement the idea, formal analysis refers to the "comparable firms" method: it reduces to the calculation Estimated Value= V1 def. as =m1*EPS1 where m1 def. as = median(P/EPS1) for the relevant pool of "comparable firms", in this case the set of SP500 firms.[iii] (More complete notation appends a subscript j, the firm, to V1 and EPS1, but not to m1; also, a subscript t is implicit for all variables). The percentage valuation error in absolute value terms, absv{P-V1}/P}, measures the efficacy of the model of EPS1 for each firm/date. (These always positive error measures should be distinguished from signed errors.) The section proceeds to evaluate how this model's valuation errors compare to the errors of its immediate alternative, referred to as model V2, where EPS2 and m2 = median(P/EPS2) replace EPS1 and m1. The section resolves the question.

Section 3. The "comparable firms" method, which underpins both V1 and V2, can be generalized by combining the two models into a weighted average model, denoted by V3. Such a "combo model" raises the issue of how to specify the weights attached to V1 and V2. The section develops a simple principle based on the relative accuracy of V1, V2, and V3. Following that, the empirics evaluate the performance of V3; it checks the extent to which V3 reduces valuation errors compared to V1 and V2. It shows that the issue of growth plays an important role.

Section 4. This section takes a closer look at the potential for the growth of AF of EPS to correlate with valuation errors.[iv] Foundation analysis correlates EPS growth with the two EPS-yields, EPS2/P and EPS1/P. Conventional wisdom posits negative correlations.[v] The empirics support this claim, but are less than what one may think. The section proceeds to evaluate whether EPS growth correlates with the (+/-) signs of P-V1, P-V2, and P-V3. The findings affect the development of more sophisticated valuation methods.

Section 5. Is EPS growth the most informative measure of growth to connect with EPS-yields? The question makes sense: an additional common-sense measure of growth derives from AF of revenues.[vi] The Section compares revenue growth to EPS growth in regression models that explain EPS1/P and EPS2/P. These correlation analyses ultimately concern the extent to which the two growth measures complement or compete with each other. The empirics in the section recognize that findings can depend on whether EPS1/P or EPS2/P specifies the dependent variable.

Section 6. Firms with relatively high economic growth tend to generate much attention. These so-called "growth stocks" are known for their high forward PE ratios (or low EPS-yield ratios). It gives rise to questions about the difficulty of valuing growth stocks: are the values of such stocks more elusive to pin down? The Section shows that the growth stocks do indeed have high valuation errors, and it provides reasons/evidence why this is so.

Section 7. Aside from EPS and revenues, risk should also influence firms' valuations.[vii] As a starting point, the empirics can address whether risk correlates with the EPS1/P and EPS2/P ratios. One can also check whether risky firms tend to be associated with greater valuation errors. A more comprehensive framework recognizes that three attractive elements -(EPS1/P, growth, and the inverse of risk)- involve trade-offs; that is, if one of these elements is improved on, then at least one of the remaining two must be worse. The empirics examine this hypothesis. Moreover, an appendix formalizes a theoretical framework.

Section 8. The section develops a mode to explain value by incorporating growth(EPS) and growth(rev), as well as the cross-sectional median of EPS2/P (or m2). This approach is based on Section 5 regressions, and it reflects an attempt to improve on V2. Though the method reduces the valuation error, the improvement is due entirely to high-risk (proxied by beta) stocks. The latter aligns with what should be expected per Sections 6 and 7.

Going beyond the above content outline, a few comments may help the reader to internalize the forthcoming analyses and discussions. The first point pertains to the background required. Readers are presumed to have had some exposure to principles of equity analysis, as spelled out in introductory textbooks. It also helps if the reader has had experience reading about equity investments/markets in financial media such as FT and WSJ, or, even better, exposure to academic research with a connection to FSA and valuation practice. As a second point, it should be underscored that all topics covered in this paper are well-known to investors who pay attention to firms' fundamentals and have a sense of their statistical frequencies. In sum, readers should hopefully feel comfortable getting exposed to empirical insights familiar to professional equity analysts.

How does the paper relate to the academic literature? Hypotheses/findings presented in this research are, to the best of our knowledge, novel. An exception pertains to Liu, Nissim, and Thomas (2002), but their data ends where ours begins. All of the tables that go beyond descriptive content are totally new, even in their motivation. Nor should the hypotheses/findings be viewed as direct extensions of what can be found in pre-existing papers. That said, of course, many narratives about how the world (most likely) works may have a familiar ring or align with basic economics. In the authors' view, to cite these would not enlighten the reader about the content of this paper (especially since the citation list could be endlessly long). Instead, the reader should always keep in mind the paper's core structure: it deals with AF of (EPS1, EPS2, rev1, rev2) as an integrated package, which identifies two measures of growth, EPS2/EPS1 and rev2/rev1 – all in order to ultimately connect with equity values.[viii]

A final point: the paper refers to EPS-yields rather than the inverse ratio, the PE. This convention makes sense insofar as P is the more solid denominator, always positive. In may event, the distribution of the PE has outliers, more so than the EPS-yields. It is also worth noting that the EPS-yields can be evaluated relative to interest rates and cost-of-capital (=discounting rates).

2. Forward EPS Yields and Benchmark Models Estimating Value.

Before looking into models that estimate value, some basic statistics will serve as underpinnings. Consider first the magnitudes and cross-sectional distributions of the EPS-yield ratios, EPS1/P and EPS2/P. Table 1 overviews.

Table 1. The magnitudes and cross-sectional distributions of the Earnings Yields

The sample includes S&P 500 Index constituents and excludes the Financial and Utilities sectors. The average number of available annual observations is 348. The forecast of EPS is the median of 12 months forward EPS at the end of each year and uses the weighted average of next year's EPS. That is, EPS1= fem/12* next year EPS + (12-fem)/12* following year's EPS, where fem is defined as the fiscal-end-month. Each year, the last closing price of each company is used to calculate earnings yields.

Year	Earnings Yield 1				Earnings Yield 2				Short Term Interest Rate
	Q1	Q2	Q3	[Q3-Q1] /Q2	Q1	Q2	Q3	[Q3-Q1] /Q2	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2003	2.5%	4.1%	6.0%	0.8	3.2%	4.7%	6.7%	0.8	0.9%
2004	3.3%	5.0%	6.2%	0.6	3.9%	5.6%	6.8%	0.5	2.3%
2005	4.1%	5.5%	6.7%	0.5	4.7%	6.2%	7.5%	0.4	4.1%
2006	4.6%	5.6%	6.5%	0.3	5.3%	6.2%	7.1%	0.3	4.9%
2007	4.7%	6.1%	7.3%	0.4	5.8%	7.0%	8.3%	0.4	3.2%
2008	5.8%	8.1%	10.1%	0.5	6.8%	9.1%	11.4%	0.5	0.35%
2009	4.3%	6.2%	7.7%	0.5	5.6%	7.3%	8.5%	0.4	0.44%
2010	4.7%	6.7%	8.0%	0.5	5.8%	7.5%	8.6%	0.4	0.27%
2011	5.3%	7.1%	8.9%	0.5	6.3%	8.0%	10.2%	0.5	0.11%
2012	5.1%	6.8%	8.1%	0.4	6.0%	7.6%	9.4%	0.4	0.15%
2013	4.7%	5.8%	6.8%	0.4	5.4%	6.5%	7.7%	0.4	0.12%
2014	4.3%	5.5%	6.6%	0.4	5.1%	6.1%	7.3%	0.4	0.22%
2015	4.4%	5.7%	7.1%	0.5	5.0%	6.3%	7.8%	0.4	0.61%
2016	4.4%	5.5%	7.0%	0.5	5.0%	6.0%	7.6%	0.4	0.81%
2017	4.0%	5.1%	6.8%	0.5	4.5%	5.6%	7.2%	0.5	1.70%
2018	5.0%	6.4%	8.9%	0.6	5.6%	7.1%	9.8%	0.6	2.54%
2019	4.0%	5.3%	7.3%	0.6	4.5%	5.8%	7.9%	0.6	1.55%
2020	3.2%	4.7%	6.6%	0.7	3.9%	5.4%	7.5%	0.7	0.10%
2021	3.2%	5.0%	7.0%	0.8	3.8%	5.6%	7.7%	0.7	0.38%
Total	4.1%	5.7%	7.3%	0.6	4.7%	6.4%	8.1%	0.5	

Interest rate data: https://fred.stlouisfed.org/series/DTB1YR#0

Two common-sense aspects should be noted. First, the (*cross-sectional*) average (*forward*) EPS2/P exceeds EPS1/P for every year. The result conforms to basic economics since AF of EPS2 should reflect future expected growth (since earnings generally exceed dividends). Second, the average EPS1/P ratio exceeds short-term interest rates every year. This makes economic sense insofar as growth must generally co-exist with risk. Turning to cost-of-equity(=r), though not directly observable, it should (on average) exceed EPS1/P due to conservative accounting combined with growth. (Given RIV, P=BV+ (EPS1 -r*BV)/(r-g), the inequality EPS1/P<r follows from r=(EPS1/P) + g*(1-BV/P) and balance sheet conservatism, BV<P)

Finance textbooks illustrate cost-of-equity using rates of at least 6%. Since the grand average EPS1/P equals 5.6%, the *two inequalities*

r(f) < EPS1/P < cost-of-equity

provide "typical" upper and lower thresholds for the earnings-yield variable.

Though the average cross-sectional EPS-yields are reasonably steady over time, the variation *across* firms in any one year is considerable – Q3- Q1 often exceeds 3%, in both cases of EPS-yields.

Columns (4) and (8) provide the Coefficient of Dispersions (CofD) for the EPS-yields. For each year, the variance Q3-Q1 is scaled by Q2 to normalize the cross-sectional variations. Columns (4) and (8) show that for most years, the CofD of EPS1/P exceeds those of EPS2/P. Considering this difference (8) vs (4), one should expect EPS2/P to be more informative than EPS1/P about stocks' prices. The remainder of this section deals with this aspect of Table 1.

To address the relative informativeness hypothesis, it compares the two benchmark valuation models based on AF of EPS for "comparable firms, all SP 500"):

V1=m1*EPS1; m1=median(P/EPS1)

and

V2=m2*EPS2; m2=median(P/EPS2)

Absv{(P-Vi)/P}, i=1,2, measures performance. For each year, the median, across firms, summarizes the valuation errors. The median across all years summarizes a model's "bottom line" performance. The results are as follows:

Table 2. Valuation errors – V1 and V2

Notation: m1 is the cross-sectional median forward P/E where E=EPS1 for each year; m2 is the median forward P/E where E=EPS2 for each year.

	Valuations Error (%): absv(V-P)/P		% obs across years
	V1=m1*EPS1	V2=m2*EPS2	Error V1 > Error V2
Median	26%	23%	62%
Max	40%	38%	69%

Min	17%	15%	56%
		# of years where V1 error exceeds V2-error by 50%: 19/19	

V2 performs better than V1: *average percentage errors of23% vs.* 26%. The max and min numbers are supportive as well. For all years, V2 performs better than V1. Perhaps the far-right column persuades the most; it compares which of the two models is the most accurate across all observations, firms, and years: V2 beats V1 62% of the time.

V2's dominance should be expected: the yearly average CofD for V1 exceeds the one for V2. (Indeed, across years, the valuation errors rank- correlate almost perfectly with the CofD; the correlations equal 96%(V1) and 98% (V2)).

3. Combining V1 and V2.

An obvious question arises: to improve on V2, why not try to combine V1 and V2? An intuitive, appealing approach relies on a weighted average since both V1 and V2 are effectively unbiased; it makes the weighted average unbiased too. The weights used are -1 and 2, that is, V3 = -V1+ 2*V2.

To motivate the weights (-1,2), consider the limited information about the three models' expected relative performance. Two observations apply. First, rank the 3 models per hypothesis: V3 should, ideally, work better than V2, which in turn should work better than V1. Second, V2 can be viewed as a simple average of the best model, V3, and the worst model, V1. *The analysis accordingly reduces to the value estimate V2 = {V3 + V1}/2, that is, the weights (-1,2).*

Though the weighting scheme lacks an empirical foundation, it can be motivated by "incomplete understanding rationality". More of an economic justification, EPS2 reflects more information than EPS1 since all information relevant to forecasting EPS1 enters the forecast of EPS2 as well. Thus, the EPS2 forecast deserves a greater weight because it embeds growth: fixing EPS2, the less the EPS1, the greater the growth, and the greater the implied estimate of value.

Table 3. Valuation errors – V2 and V3

	Valuations Error (%): abs(V-P)/P		% orbs
	V2=m2*EPS2	V3= -V1+ 2*V2	Error V2 > Error V3
Median	23%	23%	54%
Max	38%	36%	62%
Min	15%	15%	46%
		# Years that exceed 50%: 17/19	

Referring to the broad error metric, the table's two left columns show that the median percentage errors are about the same,23%. But strictly speaking, this "about the same" outcome misleads. A more refined metric, in the far-right column, compares outcomes for the individual observation: P is closer to V3 than V2 in 54% of all observations. Moreover, V3 beats V2 in all years but 2. *Accordingly, the statistical evidence shows that V3 outperforms V2 (as well as V1), though, at the same time, V2's better performance lacks materiality.*

The limited improvement, V3 vs. V2, may occur because the two underlying ingredients (V1 and V2) are too similar. To assess this possibility of "weight irrelevance", consider the rank correlation of the two underlying models' errors (P-V1)/P and (P-V2)/P. Now the signs are part of the error measurements. Hence, a distinct positive correlation occurs when the errors have the same sign for most observations. As an average correlation (not reported on) across the years is no less than 0.94, the finding supports the hypothesis that the two models are " too similar to be usefully combined". In sum, the finding suggests that a change in the weights (-1, +2) is unlikely to *materially* improve the combo model's performance.

To improve the explanation of P, a closer look at the nature of growth will be necessary. The next Section addresses the topic in some detail. However, as a slight detour, it helps to illustrate the role of idiosyncratic observations. This aspect cannot be neglected when one constructs valuation models; growth stocks produce outliers, which must be isolated and treated separately.

The relevance of eliminating outliers can be illustrated. Consider the use of the book-to-market (BTM) ratio as a criterion. Specifically, if the BTM>0.8 or <0.2, the observations are relatively extreme and thus eliminate 20% (roughly) of all observations. Results show that the error rates for V1, V2, and V3 now equal, respectively, (21%, 19%, 20%). These rates can be compared to the originals (26%, 24%, 23%); thus, the scheme that eliminates such extreme BTMs reduces the average errors materially. That said, given the data, moving from V2 to V3 shows no improvement. Such an outcome occurs because the elimination of outliers includes an excess of growth stocks, which plays a role (as was shown earlier) when one tries to explain V3's improvement on V2.

The next section examines the importance of growth starting from the basics, EPS growth.

4. The Relevance of EPS Growth

Concurrent with the forward EPS/P, practical stock valuation pays great attention to earnings growth, often considered on an EPS basis: everything else constant, the greater such expectation of growth, the more valuable the stock.

As a starting point to appreciate growth, consider the descriptive EPS2/EPS1 statistics. Table 4 provides Q1, Q2(medians), Q3, and the Coefficients of Dispersion (CofD) for the 19 years. For comparison purposes, the Table also reports on revenue growth. (These will be examined in some detail later)

Table 4. EPS Growth and Revenue Growth

The sample includes S&P 500 Index constituents and excludes the Financial and Utilities sectors. The average number of available annual observations is 346 every year. EPS growth = (EPS2/EPS1)-1. Revenue growth = (Revenue2/Revenue1)-1.

Year	EPS Growth (%)				Revenue Growth (%)			
	Q1	Q2	Q3	[Q3-Q1] /Q2	Q1	Q2	Q3	[Q3-Q1] /Q2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2003	10%	14%	22%	0.9	3%	6%	11%	1.2
2004	7%	13%	18%	0.8	3%	6%	9%	1.1
2005	8%	13%	17%	0.7	3%	6%	9%	1.1
2006	8%	12%	16%	0.7	3%	6%	9%	1.0
2007	9%	13%	17%	0.6	4%	6%	9%	0.9
2008	7%	12%	18%	1.0	2%	5%	8%	1.2
2009	9%	14%	23%	1.0	4%	6%	10%	1.1
2010	8%	13%	18%	0.8	4%	6%	8%	0.9
2011	9%	12%	16%	0.6	3%	5%	9%	1.0
2012	9%	12%	17%	0.7	3%	5%	9%	1.0
2013	8%	11%	16%	0.7	3%	5%	8%	0.9
2014	8%	11%	15%	0.6	3%	5%	7%	0.9

2015	8%	11%	14%	0.6	3%	5%	7%	0.9
2016	7%	10%	14%	0.7	3%	4%	6%	0.8
2017	7%	10%	14%	0.8	3%	4%	7%	0.9
2018	7%	11%	15%	0.7	3%	5%	7%	0.9
2019	7%	10%	14%	0.7	3%	5%	7%	0.9
2020	8%	11%	18%	0.9	3%	5%	8%	1.0
2021	7%	10%	15%	0.8	3%	5%	8%	0.9
Averages	8%	12%	16%	0.8	3%	5%	8%	0.9

Results show stable numbers across the years, with a median of 12% and a relatively narrow range of 10-14%. The CofD is similarly close to unchanging across the years.

Common knowledge, textbooks, and academic papers all underscore that a forward EP should relate negatively to earnings growth. To evaluate the hypothesis, one can correlate EPS2/EPS1 with the two EPS-yields, EPS1/P and EPS2/P. The empirics support the hypotheses, but the negative correlations are arguably less than impressive, at least for EPS2/P. Per Table 5, the EPS1/P correlations are solid with a range of [-0.22, -0.50] and a 19-year average of -0.37. Turning to the EPS2/P and EPS growth correlations, while these correlations are also negative, the range is now low (0,04, -0.37).

Table 5. Correlations between earnings yields and growth

	EPS1/P & EPS G	EPS2/P & EPS G
Median	-0.37	-0.18
Max	-0.22	0.04
Min	-0.50	-0.37

Moreover, for EPS2/P, the correlation is effectively zero/negative for 2 out of the 19 years (not reported) in the table. To summarize, while *the Corr(EPS2/P, EPS(growth)) on average shows the correct negative signs, the result challenges the economic significance. In contrast, the EPS2/P case is clear-cut.*

The above results help to explain the V3 model's relatively small improvement on V2; in other words, it can be tied to the low (EPS2/P, EPS(growth)) correlation. First, note that the signs of P-V2 and V2-V1 should be the same to ensure V3's success. Second, it brings out that the valuation model comprises (i) a valuation-anchor (V2) plus (ii) a term that corrects for the forecasted EPS growth. To be sure, the second term is positive/negative about half the time, just like the difference between the price and the valuation anchor (P-V2), consistent with V2 serving as an unbiased anchor.

The same sign correlation, P-V1 and V2-V1, should also be positive to validate that the sign of V2-V1 captures growth. In fact, this correlation should be greater compared to the case when V2 acts as a valuation anchor simply because V1 is less effective and a worse starting point.

As hypothesized, Table 6 shows that (P-V1) and (V2-V1), on average, correlate in terms of the same signs more than (P-V2) and (V2-V1), 64% vs. 58%. Thus, V2, rather than V1, serves as the more effective evaluation anchor. Further, the evidence clearly supports that (V2-V1, EPS growth) correlate.

Overall, whilst EPS2/P reflects some of the expected growth, it does not do so fully.

Table 6. Same signs percentages

Group	P-V1 V2-V1	P-V2 V2-V1
Median	64%	58%
Max	74%	65%
Min	59%	52%

As an aside, results can be hard to interpret because of the number of shares outstanding. EPS growth, as measured by EPS2/EPS1, can potentially mislead about long-run economic performance because of the EPS-denominator, shares outstanding. The net stock buybacks are often material and thus may, at least in principle, significantly affect the forecasted EPS-denominator (the average number of shares outstanding).

Analysts must deal with this denominator aspect one way or another when posting forecasts. But it is not clear how the task is implemented. There are no known conventions, and, in any event, changes may have occurred over the two decades of data. It also seems plausible that analysts are given considerable discretion without being required to disclose the assumptions let alone the numeric details. The forecasting becomes particularly complex and murky since the denominator, in principle, must be forecasted two years ahead, in addition to the forthcoming year. Any attempt at identifying forecasting errors in shares outstanding seems far-fetched. One can surmise that analysts view the denominator specification as hard to pin down, and the result may be a material upward bias in forecasted EPS2, deliberately or not. To summarize, AF of EPS growth can end up being of dubious reliability/integrity due to an upward bias.

5. Revenue Growth in addition to EPS growth: Explaining the EPS Yields.

Revenue growth can potentially expand on EPS growth as an indicator of business growth. This measure of growth has the advantage of avoiding the per-share denominator problem associated with EPS. Moreover, the simplicity of revenue growth goes beyond the denominator since EPS forecasts must confront the inherent ambiguity of excluding "special items" in the income statement. Revenue growth is, therefore, in many ways a much more robust and cleaner measure of business growth. Its label as "the top line" thereby underscores its centrality in FSA and forecasting. (A popular saying: "Revenue growth without margin growth is preferable to margin growth without revenue growth")

Because EPS forecasting is on the murky side, analysts may be prone to promote stocks by biasing EPS growth upwards. The data support the hypothesis. Per Table 4, the median forecasted EPS growth for the 19 years is no less than 12 % (!), with a range of 10-14% across years. In sharp contrast, Table 4 further shows that the AF revenue growth over the years is in a stable range of 5-6%. Moreover, the upward EPS growth bias seems particularly plausible because *EPS growth exceeds revenue growth in no less than 89% of all observations (*not in the table*)*. Though the reason for this material discrepancy in growth rates can be multifaceted, an optimistic EPS bias seems plausible.

Do revenue and EPS growth move together, as basic economics would suggest? Indeed, the two measures of growth correlate. Over the years, the cross-sectional correlations are robustly positive, with an average of 0.6 with a range of (0.3, 0.7). Nonetheless, the correlations may act as either substitutes or complements when explaining EPS-yields.

Consider next the simple bivariate (growth, EPS-yield) correlations. Table 7.1 shows that both of the growth measures correlate negatively with both the EPS- yield variables. However, (rev(growth,)EPS-yields) correlate more distinctly than the (EPS(growth), EPS-yield) for both EPS-yields. And the negative of Corr(EPS1/P, rev(growth)) exceeds the negative of Corr(EPS2/P, rev(growth)) – just like the case when revenue growth is replaced by EPS growth. These claims are statistically robust.

A more sophisticated evaluation evaluates the relative information content of the two growth measures. Table 7.2 reports on regression models where EPS1/P and EPS2/P are the dependent variables, and on the RHS comprises the two growth variables, rev2/rev1 and EPS2/EPS1. If both variables are relevant per the hypothesis, then the estimated regression coefficients should end up negative. A more discriminating hypothesis posits that the explanatory power of revenue growth exceeds EPS growth, as should be expected given the Table 7.1 correlations.

Table 7.1. Rank correlations, EPS/P and growth

		EPS1/P	EPS2/P
EPS Growth			
	Averages	-.37	-.18
	Range	(-.2, -.5)	(0., -.4)
Revenue Growth			
	Averages	-.42	-.32
	Range	(-.3, -.6)	(-.2, -.5)

Table 7.2 Regressions, one for each year (19 years)

		Dependent Variable	
		EPS1/P	EPS2/P
Independent Variables			
Revenue Growth			
	% (of years) negative signs	100%	100%
	% negative signs with ***	89%	95%
EPS growth			
	% negative signs	100%	58%
	% negative signs with ***	68%	5%
R^2 range		(.10, .33)	(.03, .19)

The table makes it clear that (i) while both growth measures connect with the EPS-yields, (ii) the revenue growth is distinctly more material as compared to EPS growth, (iii) with respect to the EPS2/P regressions, the EPS growth overall adds little if anything beyond the revenue growth variable.

A final point in this section addresses whether revenue growth is more effective than EPS growth when trying to understand valuation errors. Previous analysis showed that the signs (plus or minus) of P-V2 and V2-V1 (sign(V2-V1) = sign(V2/V1 -1)) are the same, 57% of all cases. In other words, (P-V2) and (V2-V1) correlate using a non-parametric metric. In economic terms, if there is growth above average, V2-V1 >0, then V2 tends to fall short in the valuation, P-V2>0.

One can then ask: does the result remain about the same if the sign of [rev2/rev–median(rev2/rev1)] replaces the sign of V2- V1?

The percentage of same-sign outcomes in the revenue case equals 59%, which exceeds the 57% case. Moreover, comparing the two cases across years, the revenue growth variable performs better than the sign of V2-V1 in all but 2 years. *In conclusion, to explain the sign of the errors P-V2, the revenue growth variable performs at least as well as the EPS growth.*

The relative power of the revenue growth variable to explain P suggests that improved modelling exploits both growth measures. However, the thinking obscures the potentially bigger problem: the so-called "comparable firms" pooling methodology does not work effectively if the firms in the pool include radically different growth characteristics. As noted previously, the forward EPS/P ratios differ materially for high vs. low & average growth firms. In turn, one must now confront a much more subtle possibility: *A pool of firms all with high growth (a subset of the pool based on the S&P 500) may nonetheless embed large valuation error.* As developed next, such is indeed the case: the complementary pool of low &average growth shows lower valuation errors as compared to the pool of high growth firms.

6. Valuation Errors: Growth Stocks.

Growth stocks include large EPS2/EPS1 and also relatively small EPS1/P (and EPS2/P). In such cases, the valuation model V1=m1*EPS1 produces relatively large valuation errors insofar as m1 derives from the set of all S&P500 stocks; it follows simply because growth stocks are clearly not comparable to the typical S&P stock. With high frequency, P>V1 because the forward PEs are much greater for growth stocks as compared to stocks more generally: one should expect the errors to be large. And the same will hold for P-V2.

Growth stocks' valuation errors can persist even if the pool of growth stocks, no more, no less, determines the m1-multiple i. This section assesses the hypothesis: the (average) valuation errors remain relatively large, despite the restriction on the pool of comparable firms. The first step in the analysis identifies the characteristics of growth stocks, and the second step can then turn to the valuation errors.

Before proceeding with the two steps, it helps to motivate an expectation of large valuation errors. Consider the Section 3 findings related to CofD =(Q3-Q1)/Q2. (The Qs refer to the distribution of EPS-yields.) These statistics and valuation errors correlate negatively, and distinctly so. Given that a pool of growth firms has relatively small Q2, it should result in a large valuation error as long as the numerator (Q3-Q1) remains within a normal range. Though not a foregone conclusion, the hypothesis would seem to be reasonable.

To sharpen up the empirics of identifying growth stocks, a robust approach includes revenue growth as well as EPS growth. Specifically, the approach here requires that, in any given year, the growth stock criterion includes both EPS and revenue growth to belong to the top third. Approximately 19% of all firms fall into the "growth-firm" category (out of N=6,312).

Turning to the results, Table 8 shows the extent to which the two groups, growth vs. non-growth, differ in their medians of the average forward PEs (which support the multiples):

Table 8. Forward P/E of growth vs non-growth firms

	Median Forward PEs (multipliers)	
	Growth Firms	Non-Growth Firms
P/EPS1	24	16
P/EPS2	19	15
Implied Growth	24/19 =26%+	16/15= 7%-

These findings are as robust as unsurprising; for every year (not reported on), growth firms' PEs exceed those of non-growth firms. Materiality clearly applies in the EPS1 case: the average P/EPS1s for growth stocks exceeds the non-growth stocks (24 vs. 16; more than 50%). As expected, the EPS2 case is less distinct but still unambiguous(19/15; about 13%).

With respect to the valuation errors, the results report on the usual metric, medians, over the years:

Table 9. Valuation errors – Growth firms vs. non-growth firms

	Median absv(P-V(i))/P	
	Growth Firms	Non-Growth Firms
V1	33%	21%

V2	31%	21%
V3	30%	21%

Again, growth firms differ distinctly: the errors are much greater in the growth column. (Not reported on, the data for individual years robustly support this greater-error conclusion.) Results also show that for growth stocks, the errors decline when one moves down the column. In sharp contrast, for the non-growth stocks, the errors remain about the same across the three valuation models. These findings are consistent with the earlier sections.

The above analysis perhaps suggests that low-growth stocks should be like the opposite of growth stocks. That tends to be the case when it comes to the forward P/EPS, but not so for the valuation errors. The valuation errors are much like stocks in general. A closer look at the data shows that, for low growth stocks, Q3-Q1 is generally large (and thus so is the average (Q3-Q1)/Q2.}

To summarize the findings: *The growth stocks' forward PE ratios, compared to non-growth stocks, are materially higher and, further, end up "all over the place". The errors associated with the valuation models applied to growth stocks are therefore materially larger compared to the non-growth stocks.*

7. Rik: High- vs. Low- Risk(Beta) Stocks

Stocks differ in their riskiness, and under ideal circumstances, risk reconciles with EPS yields, growths, and, ultimately, observable valuations. That said, it is far from obvious how the data analyses ought to proceed; risk is not easily identified, and parametric models are likely to be unstable.

This section's empiric partitions the data into two (approximately) equal-sized groups: high-risk stocks (beta being greater than one) and low-risk stocks (beta being less than one). This simple approach allows for a robust analysis by avoiding parametric modelling requiring a difficult-to-agree-on foundation. In a similar spirit, the upfront choice of beta as a measure of risk simplifies; it avoids endless ambiguities if one starts out using a broad set of potential risk measurements.

The greater the risk, the lower the stock price is viewed as a truism. Lurking in the background must be notions of "all else constant", so the claim ends up on the vague side. Nonetheless, as an initial step, it makes sense to evaluate whether the two risk-groups differ in their EPS-yields: Do high-(low-) risks have, on average, high (low) EPS-yields?

Table 10, first two columns, shows that, across years, the two risk-groups have approximately the same average EPS1/P, both about 6%. Regarding EPS2/P, the difference, low- vs high- risk grouping, is 6% vs 7%, a relatively small variation around the average 6.5%. On the face of it, these outcomes may seem to conflict with a claim that EPS-yields, on average, should be smaller for the group of low-risk stocks.

However, this non-correlation finding may reflect that a risk and EP-yield connection requires controls for growth. The claim takes on plausibility since growth and EPS-yield correlate. It leads to an underlying issue: do high- and low-risk stocks differ in their growth? Table 10 answers this question in the two columns to the right.

Table 10. High- vs Low- Risk Stocks: Differential Yields and Growth

		EPS1/P	EPS2/P	EPS Growth	Revenue Growth
High-Risk					
	Average	6 %	7%	13%	6%
	Range	(4,9)	(4,10)	(11,19)	(4,8)
Low-Risk					
	Average	6%	6%	10%	5%
	Range	(4,8)	(5,9)	(9,13)	(4,6)

Table 10 shows that, on average, high-risk stocks' growth exceeds that of low-risk stocks. The difference holds for both EPS and revenues. In the case of EPS growth, the result applies for all years (not shown in the table), and the average difference is no less than 3% (high-risk 13% vs. low-risk 10%). With respect to growth in revenues, the result is more modest: the difference is 1% (6 % vs. 5%), and the dominance hypothesis holds only for 11 of the 19 years. These positive correlations, risk-group and growth, pick up on the popular saying: "*Growth and risk tend to be linked*."

To complete the analysis of the triplet (EPS/P, risk, and growth), consider next the EPS/P and growth correlation, conditioned on the binary risk-groups. Thus, for each risk-group, calculate the 4 yield-growth correlations: (EPS1/P or EPS2/P) and (growth(EPS) or growth(rev)). These risk-conditioned correlations can be compared when the risk grouping is not controlled for. Do the correlations improve?

Table 11. 4 Correlations: Earnings yield and growth for the two risk classes

	EPS1/P	EPS2/P		
EPS Growth	1	2		
Revenue Growth	3	4		
Correlations:	1	2	3	4
No-Risk Grouping	-.29	-.16	-.33	-.27
Risk grouping:				
High Risk	-.36	-.19	-.48	-.40
Low Risk	-.38	-.23	-.42	-.32

The results are clear enough: (*i) the risk conditioning improves the growth and EPS-yield correlations compared to the no-risk pooled data. (ii) Overall, the two groups of risks have about the same correlations. (iii) The dominance of revenue growth, compared to EPS growth, holds throughout (column 3 dominates column 1(.33>.29,.48>.36,.42>.38), and column 4 dominates column 2(.27>,16,.40>.19,.32>.23)).*

The above suggests that firms with high EPS1/P (and EPS2/P) and high growth (revenues and EPS or both) have relatively high risk (beta>1), on average; conversely, low EPS1/P (and EPS2/P) and low growth imply low risk.

The last hypothesis can be validated directly by comparing the two cases, (high yield, high growth) vs (low yield, low growth) in terms of the groups' average risks; the former should be high and the latter low.

To proceed explicitly, consider the set of firms with relatively high elements of (EPS1/P, EPS growth, revenue growth). In this context, the requirement of "high" for each of the three characteristics means the top 1/3 of all firms. In such cases, the proportion of firms with above-average risk equals 71%, and the proportion is greater than 50% in 17 /19 years. (Replacing EPS1/P with EPS2/P does not change the results in any substantive way.) Turning to stocks where the two attributes (EPS-yield, growth) are now low rather than high, the proportion of high risks turns into a relatively low 30%. A general principle therefore, applies in those *appealing characteristics involve trade-offs: fixing EPS1/P or EPS2/P, high growth ("good") comes with high risk ("bad").*

The appendix formalizes this above using assumptions that imply parsimonious closed-form valuations.

Finally, consider the valuation errors (absolute values, P-normalized) related to the two groups of low- vs high-risk stocks. In the former case, (V1, V2, V3) errors equal (22%,21%,21%), which compares favourably – and distinctly so—to the errors of the high-risk stocks, (31%,28%, 26%). See Table 12. The result captures the idea that high-risk stocks include a high proportion of growth stocks, which, per the previous section 6 showed that such stocks result in large valuation errors.

Table 12. Valuation errors – High beta stocks vs Low beta stocks

		High-Risk Stocks	Low-Risk Stocks
V1			
	Average	31%	22%
	Range (N=19)	(21,41)	(14,38)
V2			
	Average	28%	21%
	Range	(19,38)	(12,38)
V3			
	Average	28%	20%
	Range	(19,36)	(13,37)

To summarize, *high-risk stocks, which typically satisfy growth characteristics, are associated with greater valuation errors.*

8. Improving the Explanation of Price: the model V*.

Previous sections, 5 in particular, suggest how to reconfigure prior models to better explain the current price based on the forecasts. Consider a modification of V2, rather than V3, since the added sophistication of V3 reduced the errors only marginally. Thus, the objective is to modify EP2/P via informative variables to account for the ratio's cross-sectional variation, keeping the cross-sectional mean unaffected; in other words, the model should explain EPS2/P much like what Section 5 offered. Given such a model, let the projected value of EPS2/P be denoted Yield*. This model should satisfy the property Var[Eps2/P] >Var[Yield*] subject to the same means.

To implement the required model properties, one can simply run regressions, for each year, where EPS2/P specifies the dependent variable and the independent variables are: growth(EPS), growth (rev), and an intercept. In these regressions, Yield* =the projected dependent variable. A previous section showed negative estimated coefficients, consistent with conventional wisdom.

Following this regression analysis, the valuation model reduces to:

$$V^* \text{ def. as } = (1/\text{Yield}^*) * \text{EPS2},$$

Valuation errors are inferred from absv[(P-V*)/P], conceptually no different from the previous error evaluations. To be sure, note that V*=V2 if and only if both of the growth variables are irrelevant in the regression. At the opposite extreme, if the regression is perfect (R**2=1, which is of course not the case), then the pricing errors would be zero.

As the final step in the analysis the data is split into the two approximately equal-sized risk groups: above and below 1 beta. Accordingly, the specifics of the Yield*-calculation differ for the two risk groups because the estimated regression coefficients differ.

As an initial observation concerning the results, it is well to note that, on average, the high-risk firms have materially higher valuation errors, no less than a 5% spread. It confirms the important point that the two groups differ. (The result also reassures, considering prior analysis of high- vs. low-risk firms.) With this high/low risk dichotomy controlled for, the V* -errors are shown to be less than those of V2.

Table 13. Valuation-Errors, V* and V2

	V* -Errors	V2 -Errors
	Average (Min, Max)	
Risk Group:		
High	*0.24* (.16,.33)	*0.26* (.17,.36)
Low	*0.19* (.13,.34)	*0.20* (.13, .33)
Prob V2-Err > V*-Err	*57%* (51%,62%)	

As noted, V*'s error rate is less than V2's. That said, the last row in the Table 13 underscores that V*'s errors are less than those of V2 in every year. (Not part of the Table, the average error in a year for V2 strictly exceeds V* in only one year.) More importantly, *the first row shows that V*'s superiority is attributable entirely to the group of high-risk firms.*

Convincing as the statistical evidence is, V* vs V2, one can still argue that the economic materiality is not impressive. Though this matter is, of course, subjective, the suggestion recognizes that there could be more of an improvement if the regression were more informative. One can ask: what about non-linearities and RHS variables that go beyond growth?

Characterizing the results from a broader perspective, the big picture is unambiguous. For low-risk stocks V2, V3, and V* all work about the same. Attempts at lowering the implied valuation errors via growth adjustments lack relevance for low-risk stocks: the comparable earnings method serves as "an effective method, which is hard to improve on via growth controls". In contrast, for high-risk firms, the starting point V2 reflects relatively large valuation errors, but these can be mitigated by exploiting a material negative correlation, revenue growth, and EPS2/P. Arguably, this message concerning the difference between high- vs. low- risk stocks has not been generally appreciated, yet it should be of interest to practitioners who ask the revving-up question: Why is the stock trading at $XX? How to proceed depends on the firm's risk.

9. Summary.

The paper started out raising a broad yet self-evident question: "What are the useful empirical facts about forward Earnings and E/Ps and their connection to value?" Importantly, this thinking is predicated on the idea that a stock's price depends on beliefs about the future, captured by first-cut credible forecasts, namely those of professional analysts. It naturally leads to the centrality of forward EPS-yields and their inverses, the forward PE – a focus which aligns with investment practice. As the analysis proceeds, especially following section 3, it invokes an expansive perspective which considers forecasted growths, and, ultimately, risks to connect with forward EPS/P.

The main conclusion can be summarized as follows.

….. Typical forward EPS1/P in the cross-section hovers around 5-6%. These ratios exceed the short-term interest rates, though they are arguably less than the cost of capital. EPS2/P is somewhat larger, on average across years, at 6.2%. In terms of cross-sectional variability, the interquartile range, Q3 – Q1, is (in any given year) in the 3-4% range. The range is large enough to imply that the "comparable firms" method of value estimation comes with significant median valuation errors of 24% (V2) and 26% (V1). While the method helps as a starting point to explain value, it is less informative than what one may have hoped for.

…. The comparable firms' valuation method, as applied to SP5500 firms, works better for EPS2 (or V2) than EPS1 (V1). The dominance of V2 holds across all years. (As noted, it aligns with the prior literature.)

…. The combo-model V3 = V2 +(V2-V1) reflects an attempt at incorporating growth in the valuation, through the term V2-V1. Though EPS growth explains EPS1/P and EPS2/P (negative correlations), the improvement is modest. Part of the issue relates to the fact that most firms have "average" growth.

….. The EPS2/P and EPS growth correlations are much closer to zero than the (negative) correlations of EPS1/P and EPS growth. There are two implications. First, V1 should perform worse than V2, as was found. Second, the low correlation of EPS growth and EPS2/P makes it unlikely that V3 can improve much on V3, also found.

…. Revenue growth is more powerful than EPS growth as an explanatory variable of both forward yields, EPS1/P and EPS2/P. The finding is robust and compelling. Especially so because the EPS growth magnitudes are generally materially exceeding the revenue growth.

……The difference between revenue growth and EPS growth is about 5% vs. 12%. It suggests that the EPS growth measures are problematic and potentially associated with measurement problems, including excess bias in the EPS growth due to the (forecasted) per-share denominators.

…. The evidence supports that so-called "growth stocks" -- stocks with high EPS and revenue growth -- are fundamentally different from non-growth stocks. The stocks have materially higher forward PE, consistent with standard wisdom. Moreover, the growth stocks have greater valuation errors and thus are more difficult to value.

….. Stocks screened on high- vs low-risk stocks do not correlate with the (forward) EPS/Ps. In other words, it is not the case that EPS1/P correlates positively with risk. However, controlling for growth leads to a very basic intuitive rule: Stocks with high EPS/P and high growth (EPS) are much more likely to fall into the category of above-average risk.

…..To explain equity values, it is critical to note that introducing growth, especially revenue growth, can make a difference. But it comes with a qualifier: it works only for firms with above-average risks. More generally, to connect EPS yields and growth, it helps to treat high and low risk firms as separate groups.

As a final observation, it is well to note that successful equity valuation may well go beyond this paper, that is, beyond (EPS1, EPS1, rev1, rev2, beta-risk). Cash flows, book values, and turnover ratios serve as examples. However, it is far from clear how one should proceed to achieve sharper insights about current market values.

APPENDIX

Forward E/P, Growth, Risk:

Can All Three Be Improved On?

Given the three attributes, which bear directly on a firm's investment appeal, this appendix identifies the nature of the restrictions placed on the opportunities. Though intuition suggests that positive attributes cannot be freely available, the more subtle problem concerns how to specify a model that permits sensible conclusions. Accordingly, this appendix formalizes a valuation model that spells out the trade-offs of the attributes, that is, the admissible space of opportunities.

When investors try to judge a stock's attractiveness, what are the financial attributes of primary interest? In principle, an answer can be all over the place, such as long-term cash flows (high), market-sales growth (high), dividend payout (high), leverage (low), profitability(high), the growth of its industry (high), risk(low), earnings volatility (low), etc. Here we put forward a common-sense, first-cut triplet: the forthcoming expected forward EPS/P (high), the growth in expected EPS (high), and some measure of the riskiness (low).

The analysis assumes that the stock market is efficient, including "objective" forecasts. Given this setup, the elements (EPS1/P, EPS-growth, risk) – all three of them- cannot be improved on. In other words, there are only trade-offs available: if one attribute is improved on, then at least one of the remaining two must be less attractive. The proposition is as intuitive as it is pointed.

The theory that stakes out the hypothesis captures the spirit of the V's, but a more precise structure must be put into place.

As a starting point, consider the following two definitions:

W1 = EPS1/c, c>0, a fixed parameter.

W2 = EPS2/(c*R) where R>1, a fixed discounting parameter.

It is assumed that there are no dividends at date 1. Thus, W1=W2 if and only if the EPS growth equals R-1(= r). This can be viewed as part of a theoretical benchmark steady state; in other words, absent dividends, the discounting factor determines the growth in expected earnings, due to an increase in earnings retained. (To be sure, the notation means that EPS1 and EPS2 are the expected EPS for each of the two future periods.) This setup aligns with V1=W1 if m1=1/c and V2=W2 if m2=1/(c*R).

Next, for all firms, assume a weighted average of W1 and W2 determines the equity value:

$$P = w^* W1 + (1-w) *W2$$

where w<0. As a special case, w=-1, similar to V3 in the body of the paper.

The model works such that 3 firm-specific "choice" variables determine P, namely, EPS1, EPS2, and r(=R-1). Thus, c and w identify market-wide (fixed) parameters that apply to all firms.

One can now verify the following claim, which addresses the appendix heading:

There does not exist any two specifications (EPS1', EPS2', r') and (EPS1'', EPS2'', r'') such that (EPS1/P'', growth'', 1/r'') weakly dominates (EPS1/P', growth',1/r')

The approach has the virtue of fully aligning with the (V1, V2, V3) structure put forward in the body of the paper. But the assumptions are clearly narrow due to the requirement that V3 must equate the observed P. However, one can proceed by assuming that P= w*W1 + (1-w)*W2 +noise, where the noise term is purely random.

The assumption of zero dividends is one of convenience. One generalizes by replacing EPS2/c with the "dividend-adjusted EPS2/c" = EPS2/c +dps1, which further implies the "dividend-adjusted growth term" (EPS2 +c*dps1)/EPS1.

It is interesting to note that the modelling embeds the saying "Growth and risk come tougher". To be specific, the model implies

$$P/EPS1 = w/c + (1-w)/c * (EPS2/EPS1)/R)$$

where EPS2/EPS1 - 1=growth and R-1=r(f) + risk. Thus, the ratio (growth +1)/R determines the forward P/E; it is high(low) if and only if growth (low) is relative to risk.

A final comment pertains to the absence of growth in AF of revenues. This vacuum is basically due to the limits of the theory. Without theory, one can still extend the precepts to the quadruplet {E-yield, growth (EPS), growth(rev), risk} in lieu of the triplet state in the appendix heading.

ENDNOTES

[i] The literature and investment practice recognize that the starting point to address the question relies on "multiples". See, for example, Lie and Lie (2002), Bhojraj et al. (2003), Schreiner and Spremann (2007), Holthausen and Zmijewski (2012), Chastenet and Marion (2015), and Schueler (2020). Of course, P/EPS is the most popular, and EPS may refer to measures of forecasted EPS or historical EPS.

[ii] The claim applies to practice as underscored by Bradshaw (2004). The claim also applies to more “sophisticated” valuation schemes as illustrated by the well-known paper by Frankel and Lee (1998).

[iii] The literature provides many illustrations of how to put the “comparable firms” method to use, with the(general) intent of constructing profitable portfolio strategies. See, for example Alford (1992), Bhojraj and Lee (2002), Keun Yoo (2006), Holthausen and Zmijewski (2012). Naturally, the methods differ in terms of how to measure earnings and in the determinants of the pools that specify the firms which are “comparable” and the determinants/calculation of an average multiple.

[iv] When it comes to growth, it is important to distinguish modeling that treats growth as a parameter rather than as information (which changes across dates). In this regard, see Ohlson (2022), and for a complete development Peng et al. (2024).

[v] The literature has long recognized the growth EPS-yield connection. See for example Zarowin (1990), Penman (1996), Estep (2019).

[vi] The literature on AF of revenues (or sales) in a valuation context is meager. However, see Chandra and Ro (2008) and Kim and Kim (2021). More broadly, with respect to bias and accuracy of AF of revenues, see Cheng et al. (2020).

[vii] For the prior literature on growth and risk, see Beaver and Morse (1978).

[viii] The quality of AF, timeliness, unbiasedness, optimism, and the predictability of AF errors, have been extensively reported on in the literature. It is, however, difficult to identify the primary and robust conclusion because these depend on periods (recent vs relatively old), sample (small firms, differ materially from large ones) what attribute is forecasted (quarterly vs annual earnings, revisions vs outcomes, for example). Nonetheless, to get some general insights we suggest the following papers: Gu and Wu (2003), Beyer and Guttman (2011), Jung et al. (2019), Hirshleifer et al. (2021), Kaplan et al. (2021), De Silva and Thesmar (2024).

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