Analyzing Prospective Financial Information

Assessing forecasting bias

In a previous edition of Analyzing Prospective Financial Information, we discussed the process of quantifying the accuracy of financial forecasts to evaluate their reliability. When making this determination, it is also important to consider how the reliability of the prospective financial information (PFI) could be impacted by forecasting bias. This document will describe how one can determine if an indication of bias is present, potentially leading to overly optimistic or conservative estimates.

Calculating Forecasting Bias Measures

Bias may be present if there is any recurring over- or under- forecasting of one or more PFI metrics. This trend could indicate the team responsible for the projections lacks objectivity and is introducing a level of optimism (or pessimism) in the forecast. This may be intentional, such as developing budgets that are stretch goals, or driven by anchoring[1],overconfidence, or some other unconscious bias. Over- or under- forecasting could also be due to external factors, such as industry or economic events, rather than management bias.

When reviewing PFI for indications of potential management bias, the first step is to calculate forecasting bias metrics for the subject company. These metrics are then compared with a peer group to assess the bias indication relative to a benchmark. The primary forecasting bias metrics[2] referenced in this document are described below.

- **Mean Percent Error (MPE)**—This is a simple average of the percentage errors in a given data set, incorporating both negative and positive observations. As a result, the indication reflects a combination of both forecasting accuracy and bias. Because of the netting effect created by the inclusion of positive and negative datapoints, this measure will typically understate the true magnitude of the error. However, it can be a useful metric in identifying any indications of bias present in the forecast.
- **Median Percent Error (MdPE)**—This is the median of the percentage errors in a given data set, incorporating both positive and negative observations. It provides similar insights to the MPE, but it is less impacted by outliers in a data set.
- **Percentage of Observations Above or Below Forecast**—This measure divides the actual observations in a given data set into those that fall above the forecast and those that fall below the forecast. It does not provide any insight into the magnitude of potential forecasting bias, but it highlights the frequency of observed over- or under-forecasting.

[1] Anchoring is a cognitive bias of relying too much on the first piece of information received when making decisions.

[2] The forecasting bias metrics discussed in this document are not a comprehensive list. We plan to discuss additional metrics in future editions of Analyzing Prospective Financial Information.

Identifying Bias in PFI

To help evaluate whether management bias is present, one can compare historical forecasted metrics to actual results and determine if a company's actual metrics frequently exceeded (or missed) forecasted metrics.

Year	Actual amount (A)	Forecasted amount (B)	Observed difference (C) [A-B]	Percent difference (D) [C/A]	Absolute difference (E)
2020	137.77	150.00	(12.23)	-8.9%	8.9%
2019	136.49	140.00	(3.51)	-2.6%	2.6%
2018	151.76	157.00	(5.24)	-3.5%	3.5%
2017	127.44	144.00	(16.56)	-13.0%	13.0%
2016	151.38	140.00	11.38	7.5%	7.5%
Total	**704.84**	**731.00**	**(26.16)**	**-20.4%**	**35.4%**

MPE -20.4/5 = **-4.1%**
MdPE Median of Column D = **-3.5%**
Percentage of observations below forecast = **80.0%**

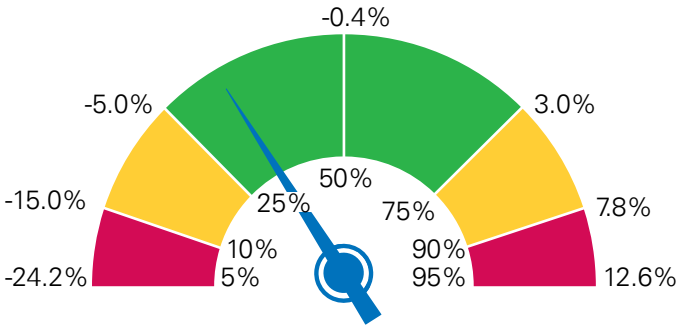
For example, assume the table above displays a company's annual historical revenue projections over the past five years. The subject company's actual results fell short of the forecasted metrics four out of five years, indicating a potential tendency to over-forecast revenue. Looking at the MPE can be helpful as well since it provides an indication of both potential bias as well as the magnitude. As noted above, the MdPE provides similar insight, but it is not as influenced by large outliers. Reviewing these datapoints in isolation does not conclusively indicate whether management has been overly optimistic in their forecast. One must see how these metrics compare to an unbiased benchmark. By comparing the differences between actuals and forecasts for similar companies, one can better assess if the recurring over-forecasting is an indication of potential management bias or due to other factors.

In this document, we will be using the MdPE and percentage of observations above/below the forecast to help evaluate potential forecasting bias. More specifically, we calculated the MdPE between the actual and forecasted revenue, earnings before interest and taxes (EBIT), and earnings per share (EPS) for each of the companies within the S&P 500 over a five year period[3]. The results of these calculations are summarized below and used for comparison to the results of the hypothetical company referenced above.

Measuring Potential Bias

Based on the table above, is there an indication of bias in the subject company's historical forecasts? To perform this evaluation, one must compare the MdPE (negative 3.5 percent) and the percentage of observations below forecast (80 percent) to other comparable companies. In this simplified example, we have assumed that an appropriate peer group for the subject company is the S&P 500[4]. To the right is the observed MdPE and range of analyst revenue percent differences over the 2016 to 2020 time period for these companies.

Difference Between Forecasted and Actual Revenue (CY2016–CY2020)



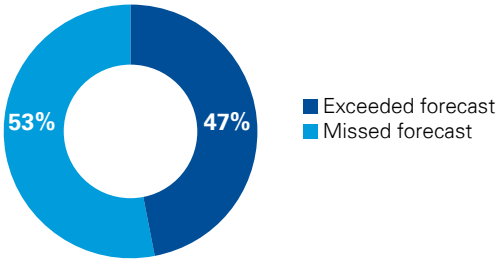
[3] The forecasted revenue, EBIT, and EPS were calculated as of the end of the prior calendar year (i.e., CY2020 forecasted revenue represents what was available as of 12/31/2019).

[4] The S&P 500 benchmark is used for illustrative purposes only. Note that using the S&P 500 as a peer group should not be considered a best practice as forecasting bias varies significantly by industry. Due to the outliers that may be present within the S&P 500 benchmark, the comparisons made between the subject company and S&P 500 may not be statistically significant.

Based on the observations on the previous page, it appears that the subject company may have exhibited a moderate level of over-forecasting bias as its MdPE (negative 3.5 percent) falls between the median (negative 0.4 percent) and lower quartile (negative 5.0 percent) of the S&P 500 companies for this period.

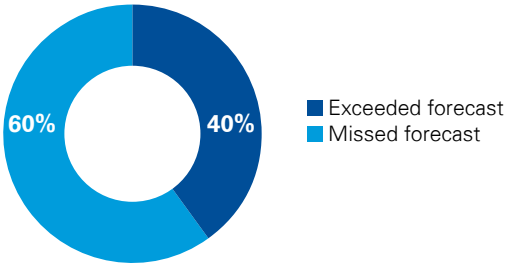
In addition, the percentage of observations falling below the forecast (80 percent) is larger than that observed for the peer group (53 percent), further supporting the view that an over-forecasting bias may be present.

Directional Revenue Projection Bias (CY2016–CY2020)

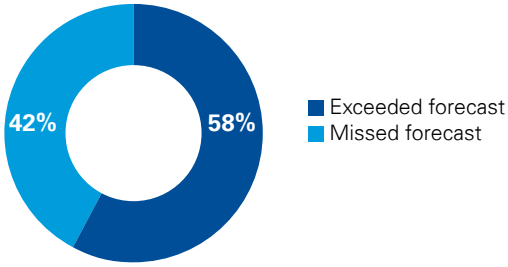


If we instead assume the metrics calculated for the subject company represent EBIT or EPS, how might our assessment of bias differ? As shown in the donut charts below, the observed EBIT for S&P 500 companies fell below analyst estimates 60 percent of the time. Given that the hypothetical company in our example missed its forecasts 80 percent of the time, it appears there could be some level of over-forecasting bias for EBIT. If the subject company had instead over-forecasted EPS 80 percent of the time, this would be nearly twice that observed for the peer group, thereby indicating that management may have an over-forecasting bias.

Directional EBIT Projection Bias (CY2016–CY2020)

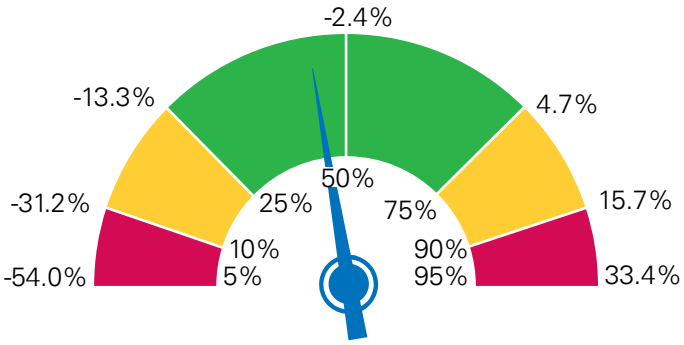


Directional EPS Projection Bias (CY2016–CY2020)

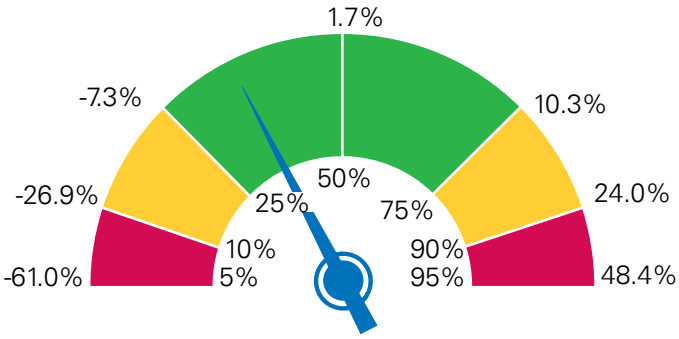


When benchmarking the MdPE of the hypothetical company to the S&P 500, it appears that there is not any significant over-forecasting bias present for EBIT as the observed difference of negative 3.5 percent is close to the MdPE of the peer group (negative 2.4 percent). For EPS, an argument could be made that the hypothetical company exhibited a moderate level of over-forecasting bias since its observed MdPE (negative 3.5 percent) falls below that of the S&P 500 (1.7 percent).

Difference Between Forecasted and Actual EBIT (CY2016–CY2020)



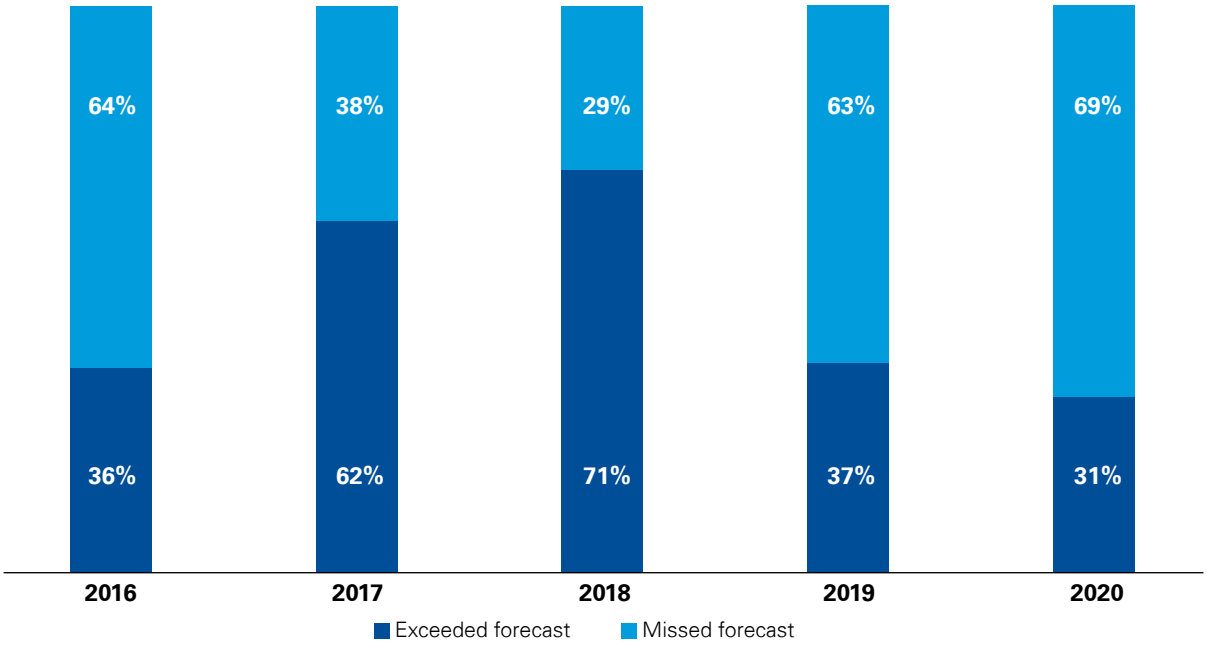
Difference Between Forecasted and Actual EPS (CY2016–CY2020)



Changes in Bias Over Time

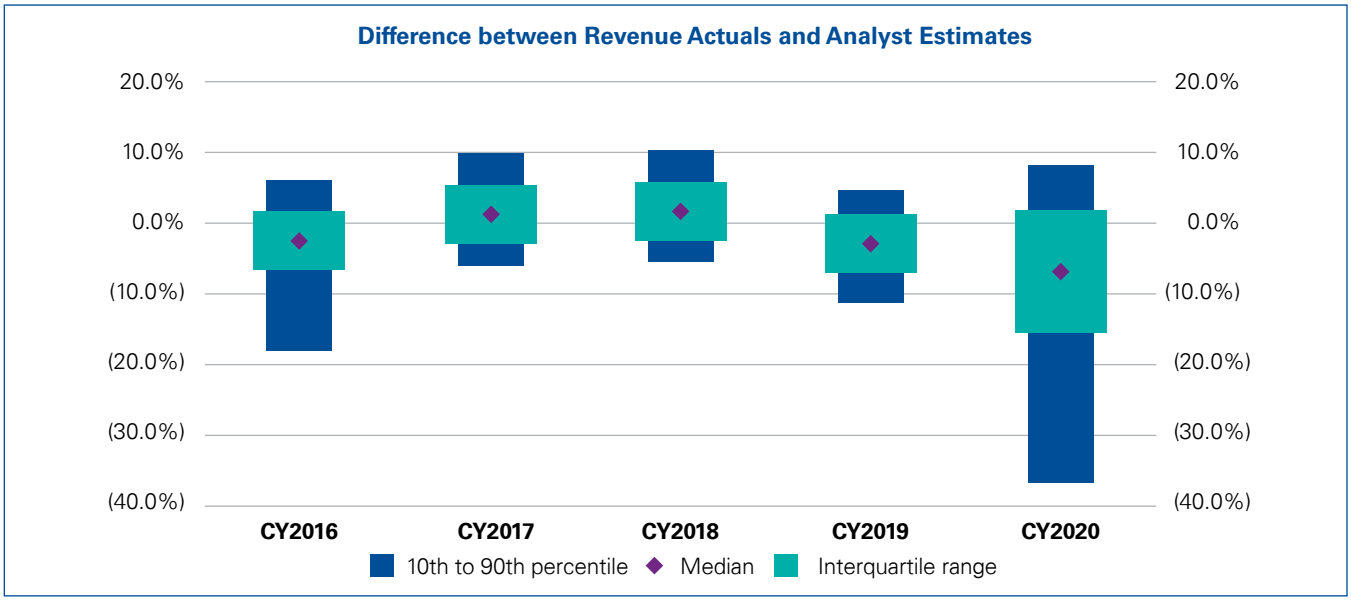
While the previous graphs provide a good perspective on bias over the recent past, it is best to make comparisons on a year-to-year basis as over/under-forecasting could be attributable to a significant change in economic or industry conditions in any given year.

Annual Directional Revenue Projection Bias (CY2016–CY2020)



As shown above, the percentage of analyst revenue forecasts exceeding (or missing) actuals varied significantly over the 2016 to 2020 time period. Not surprisingly, analyst forecasted revenue fell short for more of the S&P 500 companies in 2020 than in any of previous years of our lookback period.

As shown in the graph below, the MdPE and interquartile range for revenue significantly increased in 2020 related to the volatility and uncertainty created by the COVID-19 pandemic.



While not displayed in this document, both EBIT and EPS also demonstrated an increase in the differences between estimates and actuals in 2020. However, the proportion of companies missing their EBIT and EPS forecasts decreased from 2019 to 2020. This might suggest that many of the companies successfully took corrective action to preserve profitability in response to declining revenue.

Evaluating the Subject Company's Potential Bias

We have demonstrated that the magnitude of percent differences can differ depending on the time period examined. Let's compare the annual percent difference of the subject company to the MdPE observed for companies on the S&P 500 index. For purposes of this illustration, let's assume we are reviewing the revenue of the subject company and S&P 500. However, note that this comparison can be done for any metric, including those discussed in this document.

Year	Revenue Percent Difference		Missed/Exceeded Forecast	
	Subj.Co.	S&P 500	Subj.Co.	S&P 500
2020	-8.9%	-5.9%	Missed	Missed
2019	-2.6%	-1.3%	Missed	Missed
2018	-3.5%	2.0%	Missed	Exceeded
2017	-13.0%	1.4%	Missed	Exceeded
2016	7.5%	-1.7%	Exceeded	Missed

Since 2016, the subject company has consistently missed its revenue forecast while the S&P 500 companies missed forecasted revenue in half of these years. Further, the percent difference of forecasted and actual revenue for the subject company was worse than the MdPE of the S&P 500 in each of these years.

While it is difficult to draw any definitive conclusions with such a small sample size, the data does suggest that there may be some level of over-optimism in the subject company's revenue forecasts.

When indications of potential management bias are present, one should gain a better understanding of how the estimates were developed by reviewing the relevant methods, assumptions, and data used. When evaluating the methods used to develop a PFI estimate, one should confirm that the model used is appropriate, reliable, and mathematically accurate. In addition, one should also review the assumptions used in the model to determine if any are introducing management bias into the estimate. The assumptions with a higher degree of uncertainty, judgment, or impact on the estimate should receive the most attention. Lastly, one should carefully evaluate the data used in the development of the PFI estimate. One should focus on the reliability of the source used, the level of precision and timeliness offered by the data source, and whether alternative data sources were considered. It is also important to confirm the data is being updated periodically and in a manner that is internally consistent with other inputs and prior analyses. When reviewing the methods, assumptions, and data driving the PFI estimate, it is important to involve someone with sufficient knowledge and skills while also maintaining independence of the process.

Observations

When evaluating PFI for potential bias, one must be careful not to jump to conclusions if there appears to be a pattern of over- or under-forecasting. This could be attributable to external factors, such as the COVID-19 pandemic, that were not anticipated by any company. Careful benchmarking to forecasted results of other similar companies is key to determine if an indication of management bias is indeed present. Rather than benchmarking to the S&P 500 index, a peer group should be identified such that any bias conclusions can be drawn with more certainty. While evaluating PFI performance over longer time periods can be beneficial, it is also important to consider how results can vary from period to period. When it is determined that an indication of management bias is present, one should try to identify the source of the bias by reviewing the methods, assumptions, and data used to derive the PFI estimate.

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