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ANALYSTS EARNINGS FORECASTS DISTRIBUTION

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Abstract

Consensus measures on earnings forecasts such as the IBES mean and median are point estimates of sample distributions of analyst earnings forecasts. Often, these consensus measures serve as informational proxies for investors in their decision making process. This study utilises the Australian IBES earnings forecast data from 1988 through 2008 to show that analyst earnings forecast distributions are non-normal across the 20-year period. These results suggest the possibility of a more accurate surrogate consensus than the simple IBES mean and median. This, in turn, may have some bearing on those who generally employ analysts' consensus earnings forecasts for stock valuation and modelling purposes.

Keywords: Analysts forecasts, Earnings, Forecast distribution, IBES, Non-normality of forecasts, Mean, Median

JEL Classification: G43

1. Introduction

The literature on security analyst earnings forecasts often utilises consensus measures (mean or median) published by the Institutional Brokers Estimate System (IBES). Often, these consensus measures serve as informational proxies (Brown and Kim, 1991) used by investment advisory services in activities such as stock valuation and in gauging stock returns predictability. Thus, earnings forecast accuracy (low earnings forecast error) is desired in the making of investment decisions.

The IBES consensus measures are point estimates of analyst earnings forecast distributions. The usage of these consensus earnings forecasts within the investment community implies that analyst earnings estimates distributions are presumed to be intrinsically normal because statistical theory has shown that the unweighted mean or median are the best estimators of a normal distribution. However, if analyst earnings estimates distributions are shown to be non-normal, then a more accurate surrogate consensus may be needed. If so, this result will have practical implications for those who employ the IBES consensus earnings forecasts such as the different stakeholders of capital markets described in Kothari (2001). Specifically, a more accurate surrogate consensus may be used to derive more accurate stock valuations and allow more reliable recommendations to be made by those who provide investment advice.

Some studies, as a by-product of other research, have suggested that analyst earnings forecast distributions may possibly be non-normal (Ali, Klein and Rosenfeld, 1992; Collins and Hopwood, 1980) but no extensive empirical tests have been carried out on analyst earnings estimates distributions to examine this claim. This paper tests this hypothesis using IBES earnings forecast data and non-parametric tests of best fit to a normal distribution. The results, based on contemporaneous monthly IBES analyst earnings estimates from 1988 through 2008, are largely consistent with the hypothesis that analyst earnings estimates distributions are non-normal. The significance of the deviation of skewness and kurtosis distributional characteristics are also examined. They too corroborate distributional non-normality.

The rest of the paper is organised as follows. Section 2 develops the hypotheses in the context of the IBES literature. Section 3 discusses the data sample and the selection criteria. Section 4 describes the research design and methodology followed by the analyses of results in section 5. Finally, section 6 provides a summary of the main findings in relation to the underlying theoretical framework with a short discussion on possible future research directions.

2. Hypothesis

One germane capital markets research area is the investigation of the relationship between financial information and capital markets. Kothari (2001) indicates that this is driven by practical needs within the investment advisory services industry to seek a better understanding of fundamental analysis and valuation techniques for the added value of financial reporting. There is a constant demand for correct investment decisions in the industry and in turn a demand is placed on more accurate analysts' earnings forecasts and the consensus earnings forecast. In many instances, the IBES consensus is used to represent the underlying per period distribution of analyst earnings estimates. It is assumed with this usage that analyst earnings forecasts are *a priori* normally distributed because in statistical theory the mean or the median is the best estimate of a normal distribution (Kreyszig, 1993, p. 1219). However, it is expected in this study that empirical evidence will show otherwise.

One reason for the expected non-normal distributions is that analyst earnings forecasts contain lower or upper bounds. If so, then skewed distributions will result. Data that have a lower bound are often skewed right as are security prices; while data that have an upper bound are often skewed left. In the case of earnings forecasts, the lower bound is zero earnings per share whilst the upper bound is constrained by prior growth rate of actual announced earnings stream.[1] Hence there exists the possibility of either left or right skewness in any sample data set.

Skewness can also result from start-up effects. For example, initial analyst earnings forecasts for a firm may contain a large number of upper outliers (failures) causing left skewness in the earnings forecast distribution. As the forecast horizon[2] shortens, earnings forecast accuracy improves and forecasts tend to cluster around its mean which moves towards the actual earnings result. Collins and Hopwood (1980) point out this improvement in forecast accuracy over 4 quarters prior to the announcement date.

Thus, the following hypothesis is testable:

Hypothesis 1.

H_{null}: Contemporaneous IBES analyst earnings forecast distributions are normal.

$H_{alternative}$: Contemporaneous IBES analyst earnings forecast distributions are non-normal.

Assuming that hypothesis one holds true, the general shape of the distribution will be investigated using higher ordered moment measures such as skewness and excess kurtosis and goodness of fit testing against known distribution types.

Next, the IBES data are described and the sample data selection methodology is discussed. Our aim in this section is to develop a robust methodology to identify measures and derive robust results on this distributional characteristics of earnings forecasts.

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[1] This is based on the assumption of stable earnings streams of large-cap firms. For small-cap firms, earnings streams will be more volatile and bounds may not exist.
[2] See Appendix 1 for definition.

3. Data and Sample Selection

The analysts' earnings forecasts data are sourced from the Institutional Brokers Estimate System (IBES). The IBES data set (Financial, 2000) contains earnings per share forecasts before extraordinary items, adjusted for stock splits, stock dividends, and other capitalisation changes.

Analyst earnings estimates made for all Australian firms spanning from 1 July 1988 through 30 June 2008 are selected. Actual earnings figures are also sourced from IBES in order to minimise idiosyncratic noise in the forecast metrics because IBES applies the same adjustment process to both its earnings forecasts and actual earnings figures. The observation sample meets the selection criteria: actual earnings figures are announced annually; analyst earnings forecasts of annual actual earnings are available for all firms; analyst earnings forecasts are shifted to the next closest IBES consensus publication date occurring on the third Thursday of every month;[3] and a forecast horizon of 11 months prior to the actual earnings announcement.[4] These criteria yield 574,438 monthly earnings estimates and 264,926 monthly IBES consensus figures.

Finally, IBES uses its analyst earnings forecasts to compute its monthly consensus. IBES's computational process is governed by internal rules determining whether analyst's estimates made in certain statistical periods are carried forward into subsequent periods. First, it is predicted that an analyst estimate carry forward process is employed by IBES in its consensus computation because, in cases where an earnings estimate is published by an analyst and this estimate in the subsequent statistical period, it is neither replaced by peer analysts of the same brokerage firm nor the analyst himself/herself, then the implicit translational effect of an analyst estimate's information content into subsequent months needs to be captured. Additionally, events necessitating the exclusion[5] or stoppage[6] of estimates also

[3] This criterion implies the assumption of equal informational content within all analyst estimates announced between two monthly IBES publication dates.

[4] This ensures the study focuses on analyst earnings forecast distributional characteristics results which are current in relation to the subsequent actual earnings. The rationale underlying the omission of earnings estimates 12 months prior to actual earnings figures is due to the possible distortional effect the information content of a firm's previous actual earnings figures may have on analyst earnings estimates made in that same month but which contribute to the actual earnings of the subsequent period. (Brown, Lee, Taylor and Walter, 2004)

[5] Excluded estimates denote those estimates made in a statistical period but not included in the IBES consensus calculation. These forecasts have deviated from accepted standard as defined by the majority of analysts covering a particular issue. IBES contacts the analysts making these forecasts for confirmation regarding the exclusion and queries the methodology behind the estimates.

[6] Stopped estimates indicate when a brokerage firm's analysts removed his/ her earnings forecast from the IBES database due to conflict of interest between the brokerage firm and the company for which earnings are estimated. Examples of causes of earnings publication stoppage include a brokerage firm underwriting a firm's equity issues or when the investment banking

need to be incorporated. For example, earnings estimates made in a statistical period needs to be carried forward into subsequent periods until a new estimate is made by the same analyst or when an estimate publication stoppage is being placed on the brokerage firm for which the analyst is employed. These stoppages may be due to a variety of reasons including underwriting agreements between the brokerage firm and the firm for which earnings estimates are made. An understanding of the different IBES processing rules ensures the distributions of analysts' earnings forecasts undergoing tests of normality are consistent with the ones IBES use to generate its consensus.

Employment of the IBES processing rules to the filtered subset yields 303,016 monthly earnings estimates and 42,730 monthly IBES consensus observations for the time period 1 July, 1988 through 30 June, 2008. Table 1 shows the change in sample size as a result of the filtering process.

Table 1. Elimination of Firms and Estimates Due to Data Cleansing and Employment of IBES Internal Rules

Criteria		Number of IBES Analysts' Annual Earnings Forecasts	Number of IBES Consensus (mean and median counted as 1 consensus)
(1)	**Original non-US source data set**	9,144,148	7,569,139
(2)	**Post sample data selection and cleansing process followed by extraction of Australian data**	574,438	264,926
(4)	**Carry forward estimates and application of IBES internal rules.**	1,212,064	251,354
(5)	**Select data from years 1988 through 2008**	303,016	42,730

The next section discusses the research design of this study.

4. Research Design

4.1 Forecast Horizon and Observation Interval

A monthly contemporaneous analysis of the 11 months prior actual earnings forecasts is applied across a 20-year interval from 1 July 1988 through 30 June 2008. Contemporaneous macroeconomic factors which may impact earnings forecasts are controlled in the sample that

arm of a brokerage firm is involved with the mergers or acquisition activity of the client firm.

spans over four economic cycles.[7] Possible macroeconomic factors that are considered are fluctuations in interest rates, exchange rates, business spending, consumer sentiment, and fiscal policy changes.

4.2 Forecast Error Metric – Analyst Earnings Relative Forecast Bias

Prior to the discussion of the statistical techniques pertaining to the testing of the hypothesis, it is important to refine measures of forecast bias that are used in the past forecast literature to obtain an appropriate benchmark to facilitate the study of analyst earnings forecast distribution characteristics. The main motivation of this study lies in our interest to evaluate the significance of non-normality in cross-sectional analyst earnings forecast distributions. In analyst earnings forecasts research, consensus point estimates of analyst earnings forecasts sample distributions are used in the calculation of two types of forecast error measures. These are (i) firm-based, which measures the deviation of the consensus estimate earnings away from the actual earnings, after dividing it by a deflator to achieve scaling and (ii) analyst-based, which measures the difference between an analyst's forecast error and the per period consensus of all analysts' forecast errors, again scaled by a deflator. This is termed the analyst's relative forecast error measure (following Brown, 1999).

The latter error measure is altered in this study. An *analyst earnings relative forecast (AERF) bias measure* may is defined as:

$$AERF\_BIAS = \frac{analyst\_earnings\_forecast - analyst\_earnings\_consensus}{deflator} \quad (1)$$

The use of deflators in earnings forecast research has been scarce. When attempted, they are often not sufficiently detailed to yield a generalisation of result nor robustness of result. Thus, for completeness and for robustness of results, this study employs four deflators in relation (1). They are: (i) a firm's share price at 11 months prior actual earnings are reported $PRICE_{t=-11}$; (ii) a firm's share price at each statistical period $PRICE_t$; (iii) the period's consensus analysts' earnings forecast CONS; and (iv) a modified version of the mean absolute percentage error (MAPE) as suggested by Makridakis (1993).

The fourth measure, which is denoted by mPE hereafter, operates best in a majority of situations and at the same time satisfies theoretical and practical concerns. It is able to

[7] Artis *et al.* (1997) found average economic cycles to be 51 months in duration across a study of 12 countries (G7 and 5 European countries) from years 1961 through 1993. Thus, the data sample in this study covers 20 years x 12 months/ 51 months=4.7 economic cycles.

mitigate scaling problems, is robust from one data set to another, and is protected from the influence of outliers. The mPE measure improves upon the MAPE measure by avoiding scaling problems by dividing the error (Actual-Forecast) by the average of the Actual and Forecast, that is, (A+F)/2. Hence the mathematical form of the error measure mPE becomes:

$$mPE = \left| \frac{A - F}{(A + F)/2} \right| \qquad (2)$$

where A is the actual reported earnings and F is the analyst earnings forecast.

For the purpose of this study, the per period analyst earnings forecast consensus item (CONS) replaces the actual reported earnings (A) to form the *analyst earnings relative forecast (AERF) bias* as included in equation (1).

4.3 Goodness of Fit Tests

Hypothesis 1 is tested with three goodness of fit tests using *AERF_BIAS* (relation 1) together with the deflators mPE, $PRICE_{t=-11}$, $PRICE_t$ and CONS.

The goodness-of-fit tests are the Kolmogorov-Smirnov (K-S) test, the Anderson-Darling (A-D) test and the Cramér-von Mises (CVM) test (Siegel and Castellan, 1988). All were developed to examine whether a given distribution fits a specified distribution (a normal distribution in this study). The A-D test has been modified to overcome limitations[8] of the K-S test but it is only available for a limited number of distribution types.

5. Results

5.1 Effect of IBES Internal Rules on IBES Consensus Mean and Analyst Estimates' Mean

Table 2 provides descriptive statistics on the effects of the IBES internal rules on the percentage matches between analyst estimates’ mean and the IBES consensus mean from the 1 July 1988 through 30 June 2008. Results suggest that the application of the IBES internal rules is necessary for specific analyst earnings forecasts to be identified and is, therefore, included in the sample distribution for goodness of fit tests to be carried out.

[8] The skewness in sensitivity towards the centre of the distribution and the need for the theoretical distribution to be fully specified.

Panel A of Table 2 reports the mean, median and standard deviation of the cross sectional per *Year End Period* percentage matches of the analyst estimates' mean and the IBES consensus mean both prior to and posterior to the application of IBES internal rules. Within each *Year End Period*, only those firms with analyst estimates and IBES consensus persisting from 11 statistical periods through reporting date are selected to control for sample size effects. For example, for the *Year End Period* 1994-1995, there were 2,160 (2,987) analysts' forecasts for firms which published estimates for at least 1 statistical period prior each firms' reporting date for prior (posterior) to the employment of the IBES internal rules. This was reduced significantly to 957 (2,508) when firms with at least 11 statistical periods prior reporting date were imposed for selection.

In the case of the posterior application of the IBES internal rules, the highest number of matches occurred in the financial fiscal year 1994-1995 (94.06 percent) and the lowest number of matches occurred in the financial fiscal year 1990-1991 (18.11 percent). Another result is the low matching percentage (<50 percent) in the earlier *Year End Periods* (1988-1993) and the subsequent increase in matching percentage to a high of greater than 50 percent in the later *Year End Periods* (1993-2008). A possible explanation for both the high range value (94.51 percent-18.11 percent=76.4 percent) and increase in percentage of matches from below to over 50 percent is due to the changes to internal rules used by IBES, including the amendments, removal or addition of internal rules which existed in the earlier periods but not in the later periods or vice versa. Further, these changes in internal rules may be attributable to regulatory changes or the way multiple earnings forecasts are chosen and provided by brokerage firms to IBES.[9] For example, regulatory changes include changes to the number of stoppage months placed upon a brokerage firm's estimates from when a *stop* signal is initiated by IBES.

The greater number of statistical periods of the posterior as opposed to the prior application of IBES internal rules across all *Year End Periods* is attributable to the carry forward of analyst estimates into subsequent periods which initially did not have any existing estimate(s) made by the same analyst. This implies that some firms in the data set prior to being treated with the IBES internal rules will have some statistical periods without any estimates. Since the sample selection chooses only those firms with estimates from 11

[9] Using the sample data selection process detailed in section 3, it is found that there are multiple earnings forecasts supplied by different analysts of the same brokerage firm in the same statistical period, only the most recent estimate is used by IBES in its consensus calculation.

statistical periods through reporting date, firm selection is carried out after the IBES internal rules are applied.

Table 2. Effect of IBES Internal Rules on IBES Consensus Mean and Analyst Estimates' Mean

Panel A: *Comparison of IBES Consensus Mean and Analyst Estimates' Mean Before and After the Application of IBES Internal Rules*

Year End Period	*Number of Statistical Periods*	*MATCH_PRIOR_IBES*[a] *(%)*	*Number of Statistical Periods*	*MATCH_POST_IBES*[b] *(%)*
30/06/1988 - 1/07/1989	572	2.27	1,507	19.38
30/06/1989 - 1/07/1990	627	4.31	1,507	22.16
30/06/1990 - 1/07/1991	616	4.22	1,375	18.11
30/06/1991 - 1/07/1992	594	4.88	1,540	35.13
30/06/1992 - 1/07/1993	759	4.74	1,529	46.96
30/06/1993 - 1/07/1994	902	6.32	1,837	73.43
30/06/1994 - 1/07/1995	957	7.31	2,508	94.06
30/06/1995 - 1/07/1996	858	6.76	2,794	91.30
30/06/1996 - 1/07/1997	979	5.11	2,717	84.62
30/06/1997 - 1/07/1998	1,078	7.79	2,860	87.20
30/06/1998 - 1/07/1999	1,221	6.55	3,267	71.93
30/06/1999 - 1/07/2000	1,012	8.10	3,036	78.69
30/06/2000 - 1/07/2001	990	7.17	3,707	73.37
30/06/2001 - 1/07/2002	792	9.60	3,839	85.60
30/06/2002 - 1/07/2003	864	8.94	3,294	83.23
30/06/2003 - 1/07/2004	973	6.42	3,185	92.42
30/06/2004 - 1/07/2005	987	7.82	3,832	93.11
30/06/2005 - 1/07/2006	1023	8.92	2,484	95.10
30/06/2006 - 1/07/2007	1102	7.24	3,172	94.51
30/06/2007 - 1/07/2008	1059	6.63	3,491	91.72
30/06/1988 - 1/07/2008	**17,965**	**6.82**	**53,481**	**78.92**
Mean	898	6.56	2674	71.60
Median	965	6.70	2827	83.93
Standard Deviation	185	1.84	847	27.18

Panel B: *Pair-wise Tests for Differences Between Before and After the Application of IBES Internal Rules on Matching of IBES Consensus and Individual Estimates*

Pair-wise Tests	*Statistic*	*p-value*
Student's t (t-Statistic)	9.23	(<.0001)
Sign (M-Statistic)	8.38	(0.0001)
Wilcoxon Signed Rank (S-Statistic)	67.93	(0.0001)

[a] The match percentage of IBES consensus and individual estimates' mean prior application of IBES internal rules of each Year End Period is defined as:

$$\text{MATCH\_PRIOR\_IBES}=\frac{\left(\begin{array}{l}\text{Number of firm specific IBES consensus mean equal to mean of corresponding individual analyst estimates}\\ \text{in the same statistical period within the Year End Period prior application of IBES internal rules}\end{array}\right)}{\text{Number of statistical periods within the Year End Period}}$$

[b] The match percentage of IBES consensus and individual estimates' mean posterior application of IBES internal rules of each Year End Period is defined as

$$\text{MATCH\_POST\_IBES}=\frac{\left(\begin{array}{l}\text{Number of firm specific IBES consensus mean equal to mean of corresponding individual analyst estimates}\\ \text{in the same statistical period within the Year End Period posterior application of IBES internal rules)}\end{array}\right)}{\text{(Number of statistical periods within the Year End Period)}}$$

Panel B of Table 2 reports the significance of the difference between two conditions, before and after the application of IBES internal rules. It is expected that the latter condition is significantly and positively different from the prior condition due to the expected improvement due to the application of the IBES internal rules will have on the comparison of the IBES consensus to the individual estimates' mean. The significant and positive test statistics (a p-value less < 0.05) from all three pair-wise tests, namely the Student's t test ($p<0.0001$), the sign test ($p=0.0001$) and the Wilcoxon signed rank test ($p=0.0001$) confirm this conjecture.

5.2 Descriptive Statistics

To maintain consistency and continuity in the analyses, the set of analyst detailed estimates data which have undergone the treatment of IBES internal rules in the previous section is now used to generate the set of contemporaneous distributional properties from 11 months prior through actual earnings reporting on a per month (statistical period) basis.

Table 3 provides the descriptive statistics of the analyst earnings forecast bias (AERF_BIAS) distributions using the four different deflators $PRICE_{t=-11}$, $PRICE_t$, CONS, and mPE, for all Australian IBES firms for the 20 test years. For example, the median of the fifth month prior reporting for AERF_BIAS_CONS is calculated as follows. The median of each firm-specific distribution of analyst earnings forecasts at five months prior to the firm's actual reporting date is computed for all firms. The AERF_BIAS_CONS of each median is then determined, followed by averaging all median-AERF_BIAS_CONS with the resulting mean value being the required contemporaneous median relative forecast value.

By taking the averages of forecasts summarised per period, bias values are generated across all firms. For instance, the bias of the distribution of analysts' earnings forecasts was first computed for each ASX firm at 11 months prior to actual earnings announcement. Then the mean of the bias across all these ASX firms was generated to produce a summary bias value at 11 months prior to actual earnings reporting.

Distortions to AERF_BIAS caused by zero deflator values[10] need to be addressed. Forecasts with zero deflators are removed to prevent the introduction of infinite values. For example, the deflator mPE when used with analysts' earnings relative forecast bias, is by

[10] Results for non-removal of zero deflators were found to be consistent with the case when zero denominators were removed. To avoid division by zero errors for the non-removal case, the relevant analyst estimates were assigned large relative forecast bias values of 100,000.

definition the analyst estimate plus period's consensus. If the forecast earnings value is equal to the negative of the period consensus, then the resulting AERF_BIAS_mPE value will be infinite.

Table 3: Descriptive Statistics on Contemporaneous Analysts' Relative Forecast Bias (AERF_BIAS) Distributions Using Deflators $PRICE_{t=-11}$, $PRICE_t$, CONS and mPE
Year End Period 1/7/1988 Through 30/6/2008

Months Prior to Reporting of Actual (Forecast Indicator = 1)[a]	**AERF_BIAS Deflated by Firm's Share Price at Statistical Period t=-11 ($AERF\_BIAS\_PRICE_{t=-11}$)**					**AERF_BIAS Deflated by Firm's Share Price at Statistical Period t ($AERF\_BIAS\_PRICE_t$)**				
	Median (%)	*1st Moment Mean*	*2nd Moment Standard Deviation*	*3rd Moment Skewness*[b]	*4th Moment Excess Kurtosis*[c]	*Median (%)*	*1st Moment Mean*	*2nd Moment Standard Deviation*	*3rd Moment Skewness*	*4th Moment Excess Kurtosis*
11	-0.20	0.00	0.021	0.27	0.79	-0.20	0.00	0.023	0.33	0.72
10	-0.23	0.00	0.020	0.31	0.79	-0.22	0.00	0.024	0.26	0.83
9	-0.28	0.00	0.029	0.30	0.89	-0.24	0.00	0.025	0.31	0.81
8	-0.26	0.00	0.023	0.31	0.85	-0.25	0.00	0.030	0.32	0.88
7	-0.24	0.00	0.024	0.29	0.93	-0.24	0.00	0.034	0.34	0.90
6	-0.16	0.00	0.027	0.32	0.99	-0.18	0.00	0.025	0.30	1.02
5	-0.23	0.00	0.022	0.31	1.08	-0.22	0.00	0.030	0.28	1.10
4	-0.20	0.00	0.026	0.34	1.20	-0.21	0.00	0.035	0.35	1.14
3	-0.17	0.00	0.020	0.34	1.24	-0.23	0.00	0.036	0.34	1.19
2	-0.21	0.00	0.024	0.33	1.22	-0.24	0.00	0.029	0.35	1.23
1	-0.22	0.00	0.021	0.28	0.95	-0.21	0.00	0.032	0.35	1.01
Mean	-0.22	0.00	0.023	0.31	0.99	-0.22	0.00	0.029	0.32	0.99
Months Prior to Reporting of Actual (Forecast Indicator = 1)	**AERF_BIAS Deflated by Period Consensus (AERF_BIAS_CONS)**					**AERF_BIAS Deflated by Average of Period Consensus and Forecast (AERF_BIAS_mPE)**				
	Median (%)	*1st Moment Mean*	*2nd Moment Standard Deviation*	*3rd Moment Skewness*	*4th Moment Excess Kurtosis*	*Median (%)*	*1st Moment Mean*	*2nd Moment Standard Deviation*	*3rd Moment Skewness*	*4th Moment Excess Kurtosis*
11	-2.19	0.00	0.365	0.34	0.69	-0.19	0.00	0.439	0.12	0.64
10	-1.24	0.00	0.261	0.29	0.78	-1.00	0.00	0.378	0.04	0.68
9	-1.55	0.00	0.252	0.31	0.78	-0.79	0.00	0.385	0.10	0.71
8	-3.11	0.00	0.352	0.27	0.81	-0.27	0.00	0.526	0.12	0.75
7	-1.08	0.00	0.276	0.30	0.86	-0.22	0.00	0.404	0.13	0.85
6	-1.57	0.00	0.319	0.29	0.91	4.70	0.00	0.722	0.10	0.93
5	1.65	0.00	0.493	0.33	1.01	-0.09	0.00	0.516	0.05	0.95
4	3.13	0.00	0.486	0.32	1.09	-0.88	0.00	1.070	0.12	1.07
3	-0.22	0.00	0.465	0.34	1.12	-0.23	0.00	0.500	0.07	1.13
2	1.41	0.00	0.474	0.35	1.28	0.23	0.00	0.462	0.15	1.16
1	-1.76	0.00	0.419	0.35	1.20	-0.01	0.00	0.323	0.10	1.13
Mean	-0.59	0.00	0.378	0.32	0.96	0.11	0.00	0.520	0.10	0.91

[a] All firms' cross-sectional analyst forecast bias distribution parameters such as median and the first four moments (per statistical period) were grouped by the number of statistical periods up to 11 months prior the corresponding firm's reporting date. In this way the timing differences between the earnings reporting dates of different firms and their corresponding forecast bias distributions are controlled. This was employed to all firms with year end dates 1st July 1988 through 30th June 2008.

[b] Skewness is equal to 0 for a standard normal distribution and values may range between negative infinity and positive infinity.

[c] Excess kurtosis is used rather than kurtosis. Kurtosis omits the subtraction of 3 so that for a standard normal distribution, the excess kurtosis is equal to 0 and kurtosis is equal to -3. The excess kurtosis must lie between -2 and infinity. It is termed leptokurtic when it is greater than 0 and platykurtic when it is less than 0.

The results suggest a positive bias (median less than mean) in general, consistent with prior reported empirical evidence of optimistic analyst forecast bias (e.g., Brown, 1998 and Mande, Wohar and Ortman, 2003). The median, on average, is consistently negative across all error deflator types except for AERF_BIAS_mPE. The mean is consistent with the expectation that when distributions of analysts' earnings estimates distributions are normalised to a mean of zero, the average across all firms will also be zero. The analysts optimism bias is corroborated by the other two distributional characteristics, i.e, skewness and kurtosis. These show that, on average, AERF_BIAS distributions are positively skewed and is leptokurtic in nature 11 months or less from the day of actual earnings release, suggesting that analyst earnings estimates distributions are fairly asymmetric. This result is exhibited by the positive mean skewness and excess kurtosis across the 4 deflators.

5.3 Non-Normality of Contemporaneous Distributions

Table 4 reports the results for the goodness-of-fit tests and skewness/kurtosis location tests of cross-sectional AERF_BIAS distributions in each of the 11 months prior reporting for firm years. Panel A reports the statistics and p-values of the Kolmogorov-Smirnov test, the Anderson-Darling test and the Cramér-von Mises test while panel B reports the statistics and p-values of the Student's t test, the Sign test and the Wilcoxon Signed Rank test. In Panel A, AERF_BIAS distributions reveal a rejection of fit to a normal distribution, with the D-statistic (<0.01), A-Sq-statistic (<0.005) and the W-Sq-statistic (<0.005) significantly positive for all relative forecast metrics in all statistical periods prior to the releases of actual earnings.

Panel B reports the significance of analyst forecast bias distributions' skewness and kurtosis from zero, the value expected from a normal distribution. For succinctness, only non-significant results are shown. They are relatively sparse given that there are 33 non-significant results of the 264 tests run (3 statistical tests for skewness and excess kurtosis each spread over 11 months and 4 deflators). Moreover, the 3 non-significant results for bias metrics AERF_BIAS_PRICE$_{t=-11}$, AERF_BIAS_PRICE$_t$ and AERF_BIAS_CONS may be attributable to the decreasing power-efficiency of the Sign test for large samples, with the Wilcoxon Signed rank test and the Student's t test been more power-efficient in large sample cases exhibiting opposing results.

Likewise, the overwhelmingly non-significant results (30/66*100=45%) for AERF_BIAS_mPE may have been caused by a metric dependent factor because the other 3 bias metrics have overwhelmingly reported polarised results.

Table 4: Contemporaneous Relative Forecast Distribution Normality
Panel A: *Analyst Relative Forecast Bias Distribution Goodness-of-fit to Normal Distribution*

Months Prior to Reporting of Actual (Forecast Indicator = 1)[b]	**Analyst Earnings Relative Forecast Deflated by Firm's Share Price at Statistical Period t=-11 ($AERF\_PRICE_{t=-11}$) Sample size per statistical period = 3232**			**Analyst Earnings Relative Forecast Deflated by Firm's Share Price at Statistical Period t ($AERF\_PRICE_t$) Sample size per statistical period = 3555**		
	Kolmogorov-Smirnov D-Statistic	*Anderson-Darling A-Sq-Statistic*	*Cramér-von Mises W-Sq-Statistic*	*Kolmogorov-Smirnov D-Statistic*	*Anderson-Darling A-Sq-Statistic*	*Cramér-von Mises W-Sq-Statistic*
11	0.57	1210	261	0.60	1203	261
	(<0.0100)[a]	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
10	0.57	1200	275	0.51	1245	257
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
9	0.51	1190	272	0.57	1239	265
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
8	0.56	1230	266	0.55	1245	274
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
7	0.54	1272	270	0.60	1224	266
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
6	0.53	1202	259	0.52	1269	260
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
5	0.51	1254	264	0.60	1215	266
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
4	0.58	1222	260	0.52	1234	268
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
3	0.55	1270	258	0.59	1270	259
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
2	0.58	1206	269	0.58	1235	269
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
1	0.57	1263	257	0.51	1244	258
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)

Months Prior to Reporting of Actual (Forecast Indicator = 1)[b]	**Analyst Earnings Relative Forecast Deflated by Period Consensus (AERF_CONS) Sample size per statistical period = 3550**			**Analyst Earnings Relative Forecast Deflated by Average of Period Consensus and Forecast (AERF_mPE) Sample size per statistical period = 3550**		
	Kolmogorov-Smirnov D-Statistic	*Anderson-Darling A-Sq-Statistic*	*Cramér-von Mises W-Sq-Statistic*	*Kolmogorov-Smirnov D-Statistic*	*Anderson-Darling A-Sq-Statistic*	*Cramér-von Mises W-Sq-Statistic*
11	0.52	1189	258	0.52	1025	220
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
10	0.52	1192	264	0.57	1026	227
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
9	0.54	1197	259	0.48	1121	229
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
8	0.56	1246	273	0.51	1111	226
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
7	0.58	1201	256	0.50	1085	228
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
6	0.52	1215	272	0.54	1071	226
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
5	0.58	1227	261	0.56	1117	234
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
4	0.59	1185	266	0.48	1045	230
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
3	0.58	1232	259	0.56	1075	221
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
2	0.57	1233	270	0.48	1028	226
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)
1	0.53	1236	271	0.49	1013	224
	(<0.0100)	(<0.0050)	(<0.0050)	(<0.0100)	(<0.0050)	(<0.0050)

Panel B: *Significance of Skewness and Kurtosis From Zero*[c]

Months Prior to Reporting of Actual (Forecast Indicator = 1)	**Analyst Earnings Relative Forecast Deflated by Firm's Share Price at Statistical Period t=-11 ($AERF\_PRICE_{t=-11}$) Sample size per statistical period = 3232**						**Analyst Earnings Relative Forecast Deflated by Firm's Share Price at Statistical Period t ($AERF\_PRICE_t$) Sample size per statistical period = 3555**					
	Student's t t-Statistic		*Sign M-Statistic*		*Wilcoxon Signed Rank S-Statistic*		*Student's t t-Statistic*		*Sign M-Statistic*		*Wilcoxon Signed Rank S-Statistic*	
	Skewness	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*
11				39						34		
				(0.1732)						(0.1243)		
10												
9												
8												
…												
1												

Months Prior to Reporting of Actual (Forecast Indicator = 1)	**Analyst Earnings Relative Forecast Deflated by Period Consensus (AERF_CONS) Sample size per statistical period = 3550**						**Analyst Earnings Relative Forecast Deflated by Average of Period Consensus and Forecast (AERF_mPE) Sample size per statistical period = 3550**					
	Student's t t-Statistic		*Sign M-Statistic*		*Wilcoxon Signed Rank S-Statistic*		*Student's t t-Statistic*		*Sign M-Statistic*		*Wilcoxon Signed Rank S-Statistic*	
	Skewness	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*	*Skewness*	*Excess Kurtosis*
11				37			-0.60		-19.48		-15171	
				(0.1872)			(0.6576)		(0.4603)		(0.7462)	
10							-1.63		-8.73		-27837	
							(0.1739)		(0.7809)		(0.5597)	
9							-0.77		20.91		-5827	
							(0.4787)		(0.4443)		(0.9806)	
8							-0.29		24.73		11829	
							(0.9115)		(0.3575)		(0.8015)	
7							1.14		32.42		60383	
							(0.4326)		(0.2701)		(0.2757)	
6							-0.71		-1.07		-7282	
							(0.637)		(1.0277)		(0.9489)	
5							0.32		14.77		29254	
							(0.8348)		(0.7140)		(0.3468)	
4							0.53		5.97		27892	
							(0.7356)		(1.0247)		(0.5360)	
3							0.43		-13.21		23755	
							(0.8343)		(0.7381)		(0.6057)	
2							0.68		15.26		36728	
							(0.6450)		(0.4919)		(0.3409)	
1												

[a] Parenthetical number are p-values.
[b] All firms' cross-sectional analyst relative forecast bias distribution parameters such as median and the first four moments (per statistical period) were grouped by the number of statistical periods up to 11 months prior the corresponding firm's reporting date. In this way the timing differences between the earnings reporting dates of different firms and their corresponding relative forecast bias distributions are controlled. This was employed to all firms with year end dates 1st July 1988 through 30th June 2008.
[c] Only non-significant test statistics and probabilities are shown due to the scarcity of such evidence, indicating that it may have arisen due to reasons not related to the underlying characteristics of the distribution but rather on the method of analysis such as the sensitivity of the particular significance test used.

As such, the earnings forecast dependency of the mPE deflator may have introduced skewness into the underlying bias distribution. The other relative forecast bias metrics $AERF\_BIAS\_PRICE_{t=-11}$, $AERF\_BIAS\_PRICE_{t}$ and AERF_BIAS_CONS depends on the constant deflators share price and actual reported earnings. Finally, those results not shown have significantly positive statistics (p-values<0.0001) suggesting that the skewness and excess kurtosis values are not of a normal distribution. This evidence is consistent with those previously presented.

6. Conclusions and Future Research

Prior research suggests that many facets of the analyst earnings forecast literature base their findings on the assumption that analyst earnings forecast distributions are normal. The use of the IBES consensus as a proxy for expected earnings figures in stock valuation or in the provision of investment recommendations suffers from this assumption.

Since the IBES consensus data consist of the mean and median as the point estimates representing the underlying analyst earnings estimates and that the mean and median are the best estimates of a normal distribution, then the distribution type is implied to be normal. Rather, this study shows that contemporaneous IBES analyst earnings forecast distributions are significantly non-normal, thus providing evidence that the assumption is not valid.

Once timing and informational inconsistencies are alleviated through data selection processes and implementation of the IBES internal rules, goodness of fit tests are carried out to determine whether analyst earnings estimates distributions are non-normal.

The results obtained in this paper are largely consistent with the hypothesis of non-normality. Significant non-normality is shown to be uniformally present across all periods of contemporaneous monthly analyst relative forecast distributions over 20 years (1988-2008) for up to 11 months prior to the actual earnings reporting date on a per firm in each reporting year end basis for all four metric deflators: (i) by firm's share price at each period, (ii) by firm's share price at the beginning of the 11 month forecast horizon, (iii) by period consensus, and (iv) by the average of analyst forecast and period consensus. Subsequent analyses of skewness and kurtosis distributional characteristics for the same data set also reveal results consistent with nonnormality.

This strong evidence pointing towards analyst earnings distributions to be non-normal suggests that a need for possible development of an improved surrogate consensus based alternate distribution types, which may be of interest to those investors who employ the consensus analysts' earnings forecasts for stock valuation and modelling purposes.

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Appendix 1: Glossary of IBES Data Terms

Term	Description
Analyst code	This is a unique identifier for each analyst.
Broker code	This is a unique identifier for each brokerage firm.
Estimation date	This is the date an estimate was reported by an analyst to IBES.
Excluded date	This denotes the period when analyst's forecasts which have been excluded from IBES consensus calculation. These forecasts have deviated from accepted standard as defined by the majority of analysts covering a particular issue. IBES contacts the analysts making these forecasts for confirmation or to query the methodology behind the estimates.
Fiscal Period	This is the frequency by which a company performance measure is reported.
Forecast Horizon	This is the period of time from the date the earnings forecast is made to the next earnings announcement date.
IBES Ticker	This permanently and uniquely identifies an estimate made at a certain point in time.
Reporting date	This is the date actual earnings figures are announced. Companies may not report earnings to the marketplace ranging up to 6 months after the fiscal period end date.
Statistical Period	This is the date range (approximately a month in duration) between two subsequent IBES summary consensus statistics publication. This occurs after the IBES monthly production run which occurs on the evening of the third Thursday of every month. It executes snapshots of analysts' estimates and calculates the consensus level data.
Stop date	This indicates when a brokerage firm's analysts removed his/ her earnings forecast from the IBES database due to conflict of interest between the brokerage firm and the company for which earnings are estimated. Examples of causes of earnings publication stoppage include a brokerage firm underwriting a firm's equity issues or when the investment banking arm of a brokerage firm is involved with the mergers or acquisition activity of the client firm.

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