THE NORMALITY OF FINANCIAL RATIOS DISTRIBUTION:
AN EMPIRICAL EVIDENCE OF MALAYSIAN FIRMS

Zaidi bin Isa

ABSTRACT

Many prior researches regarding financial ratios have shown that financial ratio distributions are not normal. Several researches suggest that one of the reasons why the distribution is not normal is because of the presence of outliers. Some suggest that the data should be transformed to square root or natural log if it is found that the distribution is not normal. Knowledge about the distribution of financial ratios is important especially in financial analysis. It can also help us to determine the function of financial ratios. In this research, the distribution of financial ratios from all listed companies in manufacturing and financial services industries between 1990-1995 is studied. The result shows that all ratios in manufacturing industry are not normally distributed, but after removing the outliers and being transformed, the distribution is close to normal. As for the financial industry, there are some ratios that are normally distributed. However, some ratios are still not normal although the ratios are transformed and outliers are removed. These findings indicate that using industrial average as a benchmark and parametric test is not an appropriate approach when carrying out an analysis connected with financial ratios.

INTRODUCTION

Financial ratio analysis is normally done to evaluate the financial performance of a company. There are two approaches of financial analysis. One is time series analysis, which involves the search for identifiable trends in past performance with a view to predict future performance. The other approach is cross-sectional analysis, which involves the comparison of results of a specific company against some "benchmark" (usually the industry average).

Knowledge of the statistical distribution of financial ratios is important when undertaking cross-sectional analysis for a number of reasons. Primarily, if one knows the mean and standard deviation of a particular distribution, and that distribution approximates normality, then one can

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determine the relative position of a specific company ratio within the industry. In addition, knowledge of the existence of extreme values in a distribution allows one to determine their impact upon the mean of a ratio. For example if a certain ratio is characterised by a number of outliers, either positive or negative, then a comparison of a company’s ratio against some industry mean might be potential misleading since this benchmark might have suffered some distortion. In such a situation, it would seem inappropriate to use the mean value as a benchmark for comparative purposes. In addition, using non-parametric approach, Konings and Roodhooft (1997) showed that financial ratios did not converge towards the industry average.

According to Kolari, McInish and Saniga (1989) the financial ratios distribution characteristics may have important implications for the interpretation of financial ratios. For example, if a particular value of a financial ratio falls in the 99th percentile, and if the distribution is normal, this particular firm is an outlier on the high end. If the distribution is U-shaped, the particular ratio may simply be a number in the group having relatively high values. They further note that information concerning the distributional characteristics of financial ratios also has implications for the monitoring of bank financial condition by regulatory agencies.

The distributional characteristics of ratios could also help to refine the rating process. Normal distributions are easily divided into five parts (plus or minus one or two standard deviations). However, a five point scoring system does not seem the best way to evaluate a ratio that has a J-shaped or U-shaped distribution. Such distributions might be better suited to a three-point scale rating. Moreover, regulators might benefit from knowledge of the distributional forms in making inferences. For example, since regulators seek to identify specific troubled banks, information about type I error (the probability of classifying a failing bank as nonfailing) is necessary. Information about type II error (identifying nonfailing banks as failing) would be important in establishing appropriate changes and regulations for risk-based evaluation systems. Similar extensions to financial analysis of non-financial firms are also possible.

Martikainen et al. (1995) carried out an empirical analysis of 10 ratios on Finnish listed firms. The results revealed that a large part of the time-series instability (The distribution form and parameters of financial ratio remain stable through the various years) of financial ratios pattern is caused by irregularities in financial ratio distribution. They also mentioned that if the distribution irregularities are not paid due attention, the interpretation of the underlying financial factors of firms may be affected.
According to So (1987) the finding of non-normality distribution of financial ratios is important to both practitioners and researchers. From the investors’ point of view, the specification of the distribution of financial ratios is very useful in assessing the uncertainty of their forecast. In fact, the usefulness of financial ratios in predicting bankruptcy and bond rating is determined by the underlying probability model that best describes the behaviour of financial ratios. For example, a credit manager who uses financial ratio analysis (and assumes normal distribution of these ratios) to determine the credit line of his customers may reach a decision that is greatly different from the one that assumes non-normal and skewed distribution. The finding on the probability distribution of financial ratios will also influence theoretical modeling. Some findings might rule out the use of some empirical methodologies, i.e., the ordinary least square (O.L.S) and discriminant analysis, which are commonly used for predicting bankruptcy and rating bonds. So (1994) also suggested that the non-normal stable Paretian distribution which has a fatter tail compared to the normal distribution is a good candidate to describe the financial ratio distribution compared to lognormal and mixture distribution. He also reported that the empirical evidence does not support the lognormal and gamma distributions. The fatter tails of the non-normal stable Paretian indicates that greater probability of observation occur in the tail of the distribution.

Lauritzen (1995) tried to model some ratio distributions with finite moment Pearson (1985) and Ramberg-Schmeiser (1974) systems distribution and to model some others with the stable Paretian distribution. The study showed that the different yearly distributions of a given ratio could often be reasonably modeled by a single parent population, in spite of the apparent great fluctuations in the standard deviations, skewness and kurtosis among these distributions.

Hastings (1970) mentioned that the treatment of outliers is an important, yet little discussed problem in ratio analysis. While systematic techniques such as trimming, ‘winsorization’ (changing the outlier’s values to that of the closest non-outlier) and various forms of transformation have been suggested, most techniques are somewhat ad-hoc. The general tendency of most researchers is to ignore the presence of outliers and their possible effects.

Deakin (1976) claimed that if the empirical distributions of financial accounting ratios were known then a distribution function could be found for a linear combination of ratios that could be used in a classification model. In his study he found that ten of eleven ratios analysed for manufacturing firms, were not normally distributed and standard transformation techniques also did not result in improving the normality of the distribution. Frecka and Hopwood (1983) extended the study made by Deakin (1976) and they claim that the presence of outliers has tremendous influence on the parameter estimates.
for the distributions. After removing outliers, normality or approximate normality was achieved for most of the distributions. They argued that (i) the ratios can be assumed to be gamma distributed, since applying a square root transformation to the gamma distributions gives an approximately normal distribution, (ii) the procedures suggested by Barrett and Lewis (1978) can be used to remove outliers until the distribution becomes normal. Watson (1990) considered the joint distribution of several ratios and attempted to improve their multivariate normality by removing multivariate outliers from the empirical distribution.

Bougen and Drury (1980) conducted a study of 700 manufacturing firms for the year 1975 in U.K and they found that most of the ratios were not normally distributed as a result of the existence of extreme values. Cochran (1963) suggests that removal of extreme values from the population may reduce the skewness and improve the normal approximation.

**PURPOSE OF THE STUDY**

Three competitive distributions are offered by the literature to explain the non-normality and the skewness of the cross-sectional distribution of financial ratios: (i) mixture of normal distribution (ii) the lognormal distribution (iii) the gamma distribution. This study is conducted to examine the existence of non-normality of financial ratio distributions in companies in the financial services and manufacturing industry, listed on the Main Board of KLSE. In addition, the appropriateness of several transformations techniques that were recommended by prior researchers will be tested. Hence, the following null hypothesis will be tested:

\[ H_{01} : \text{The cross-sectional distribution of non-transformed financial ratios in each industry is normal.} \]

\[ H_{02} : \text{The cross-sectional distribution of transformed financial ratios in each industry is normal.} \]

**SAMPLE AND DATA**

All firms taken as the study sample are listed on the Main Board of the KLSE. Financial data of companies in financial services and manufacturing industries from 1990 until 1995 are used. These two industries are chosen due to the fact that they were experiencing a fast growth rate comparable to the high growth of the Malaysian economy. In addition, the number of companies in both industries are large and this allows a sample that can represent the true population. The manufacturing industry comprises two sectors, namely the industrial products sector and the consumer products sector. The two sectors are combined to obtain a larger sample size and because the nature of their operations are similar. The study undertaken by Deakin (1976) combined several sectors within the manufacturing industry in his sample.
The financial services industry comprises the banking, finance, share broking and insurance sectors. The sample size in each year for both industries will vary according to the number of companies listed on KLSE. The ratios chosen are representative and can be said to cover the whole spectrum of a company’s activities. More specifically, the ratios analysed are profitability ratios (ROE, ROA, Operating Margin), liquidity ratios (Cash ratio, Current Ratio), debt ratios (Debt to Equity Ratio), activity ratios (Total Assets Turnover).

NORMALLITY TEST

Goslin (1976), Frecka and Hopwood (1983) used the chi-square test to test the normality of the distribution. The method is found to have some weaknesses as claimed by So (1987) especially when dealing with small samples. Ezzamel et al (1987) noted that a requirement of the chi-square test is that the expected frequencies in each category be not too small (less than 30), or the results may be meaningless. When the number of degrees of freedom exceeds one, Cochran (1954) argues that the test should not be used if more than 20% of the expected frequencies are smaller than five. Ezzamel et al (1987) also noted some disadvantages using $\chi^2$ test. First, the number and character of class intervals used are arbitrary. Second, all information concerning sign and trend discrepancies is ignored and finally, for small samples, the number of cells tends to be very small.

In order to resolve the problems and disadvantages of $\chi^2$ test, Kolmogorov-Smirnov with Lilliefors critical values, and Shapiro-Wilk test are used in this study. Both of these methods provide D and W test statistic respectively.

The Kolmogorov-Smirnov method is usually used by many researchers to test the normality of the distribution as shown by So (1987) and Othman (1990). The Kolmogorov-Smirnov test treats observations separately and thus information loss resulting from aggregation of categories is avoided. Moreover, the test is distribution free and is suited to small sample size. The Shapiro-Wilk test has been shown to be an effective test for normality even for samples of less than 20. According to Shapiro and Wilk (1968), the Shapiro-Wilk test was reported to be very sensitive to asymmetry, long-tailedness and outliers. They also claimed that the test seems to be the most powerful test to test the null hypothesis of normality. However, the tables are not available if n is greater than 50 (Royston, 1982). Consequently, the Kolmogorov-Smirnov test with Lilliefors critical values will be employed if the sample size exceed 50. Otherwise, the Shapiro-Wilk test will be conducted to test the normality. Bird and Mc Hugh (1987) used this method when they tried to examine the normality of financial ratios of companies, which are listed on the Sydney Stock Exchange.
TECHNIQUES OF TRANSFORMATION

If raw data does not exhibit normality then a systematic transformation technique will be undertaken. Even though Buifink and Jegers (1986) proposed several forms of transformation such as inversion, cube root, natural log and square root, nevertheless Kirk (1968) and Ezzamel et al. (1987) claimed that the most suitable form of transformation is either natural log or square root. In this study, either natural log or square root is used to transform the raw data. In addition, both methods are employed in order to preserve the comparability of results with previous evidence, which were obtained using these two techniques. The decision on which technique to be used first is arbitrary. The technique of removing the outliers is also used if the transformation technique fails to improve the degrees of normality. This is consistent with the study made by Freck and Hopwood (1983) who found that one of the reasons for non-normality was due to the presence of outliers. Finally, the technique of transformation and removing the outliers are employed if the raw data fails to exhibit normality after undergoing the process of removing the outliers. The steps of transformation can be summarised as follows: (1) The square root or the log transformation is used if the raw data fails to exhibit normality (the choice is arbitrary); (2) Outliers will be removed if both techniques mentioned above fails to improve the normality of the distribution; (3) Square root or log transformation and removing the outliers will be employed if non-normality still exists after undergoing the process mentioned in step (2).

CHARACTERISTICS OF THE DISTRIBUTION

Arithmetic mean, coefficient of variation, kurtosis and skews were used to describe the characteristics of the distribution. In the SPSS procedure, values of skewness and kurtosis are zero if the observed distribution is exactly normal. Norusis (1995) mentioned that for samples from a normal distribution, measures of skewness and kurtosis will not be exactly zero but will fluctuate about zero because of the sampling variation.

Arithmetic mean measures the central tendency of a distribution. To measure the distribution’s dispersion, coefficient of variation is used and will be calculated as follows

$$\frac{\sigma}{\bar{x}} \times 100\%$$

Skewness measures the lopsidedness of the distribution and will be calculated according to the formula below

$$\frac{m_3}{\sigma^3}$$

Where $m_3$ is the third moment
The value of skewness indicates that the distribution is skewed to the right. Kurtosis measures the 'tailedness' of a distribution, and the formula for kurtosis is as follows:

$$m_4 \over \sigma^4$$

Where $m_4$ is the fourth moment.

The technique of removing the degrees of normality. The results indicated that one of the reasons for the technique of transformation and the non-normality after undergoing the procedure is the distribution of the data. Kurtosis showed an overwhelming value particularly for companies in the manufacturing industry in the years 1992 (34.68) and 1994 (46.74). These high values indicate that in 1992 and 1994, the data is more spread out or variable than expected for a normal distribution.

The following table presents the result of ROE distribution characteristics. Except for companies in the manufacturing industry in the years 1990 and 1992 in general most of the raw data exhibited non-normality. Kurtosis showed an overwhelming value particularly for companies in the manufacturing industry in the years 1992 and 1994. These high values indicate that in 1992 and 1994, the data is more spread out or variable than expected for a normal distribution.

**Table 1**

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<tbody>
<tr>
<td>Mean</td>
<td>4.03</td>
<td>16.31</td>
<td>5.11</td>
<td>16.10</td>
<td>5.17</td>
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<tr>
<td>Median</td>
<td>1.56</td>
<td>1.18</td>
<td>1.70</td>
<td>1.22</td>
<td>1.73</td>
</tr>
<tr>
<td>N</td>
<td>44</td>
<td>44</td>
<td>44</td>
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</table>

**Notes:**
- Std Dev = Standard Deviation
- ** normal distribution
- ** = No transformation is needed
- Square root and square removal of outliers
- ** = Square root and removal of outliers
- X% = Coefficient of variation
- ** = No transformation is needed (the raw data is already normally distributed)
- * = The normality of the distribution cannot be improved.
- ** = Removal of outliers only

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The ROA distribution characteristics for both industries are shown in Table 2. The results show that the distributions for both industries across time were not normally distributed. In addition, all of the distributions in each year were positively skewed. Negative kurtosis value was found in the year 1990 (financial services industry, -0.85) and 1991 (manufacturing industry, -0.176). The negative values show that distribution peakedness was less than in normal distribution and the values were more spread from the mean.

However, after undergoing the process of transformation and removal of outliers, all of the distributions for both industries across time were close to normal distribution.

Table 2
Distribution Characteristics for Return On Asset (%)

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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Skewness</td>
<td>Kurtosis</td>
<td>Std Dev</td>
<td>C.V (%)</td>
<td>Transformation</td>
</tr>
<tr>
<td>Manu</td>
<td>10.856</td>
<td>0.735</td>
<td>0.014</td>
<td>6.369</td>
<td>0.583</td>
<td>square**</td>
</tr>
<tr>
<td>Financial</td>
<td>7.687</td>
<td>0.362</td>
<td>-0.852</td>
<td>5.053</td>
<td>1.112</td>
<td>ln</td>
</tr>
<tr>
<td>Manu</td>
<td>6.281</td>
<td>0.703</td>
<td>-0.176</td>
<td>7.066</td>
<td>0.549</td>
<td>ln square</td>
</tr>
<tr>
<td>Financial</td>
<td>3.334</td>
<td>1.422</td>
<td>1.272</td>
<td>3.401</td>
<td>0.102</td>
<td>ln square</td>
</tr>
<tr>
<td>Manu</td>
<td>3.516</td>
<td>0.792</td>
<td>0.511</td>
<td>0.908</td>
<td>0.968</td>
<td>ln</td>
</tr>
<tr>
<td>Financial</td>
<td>1.118</td>
<td>1.412</td>
<td>1.401</td>
<td>2.033</td>
<td>0.027</td>
<td>ln</td>
</tr>
</tbody>
</table>

square = square root
ln = Lognormal
In* = Lognormal and removal of outliers
square* = square root and removal of outliers

Std Dev = Standard Deviations
** = No transformation is needed (the raw data is already normally distributed)
none = The normality of the distribution cannot be improved.
*** = Removal of outliers only

C.V (%) = Coefficient of variation
manu = manufacturing
1 = D-Stat, W-Stat and Prob < W/D are values referring to the raw data
Table 2. The results show that the distribution of the operating margin in the financial services industry is more skewed and has a higher kurtosis compared to the manufacturing industry. The values for companies in the financial services industry are more spread out, with a larger spread in the 1990 and 1992 data. The negative values shown in Table 2 are due to the inclusion of companies that were not performing well in the financial services industry.

Table 3 contains the results of the distribution characteristics of operating margin. It is observed that the distributions of the ratios for companies in the financial services industry are more skewed and have a higher kurtosis compared to the manufacturing industry. The values for companies in the financial services industry are more spread out, with a larger spread in the 1990 and 1992 data. The negative values shown in Table 2 are due to the inclusion of companies that were not performing well in the financial services industry.

Table 3: Distribution Characteristics for Operating Margin (%)

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<tbody>
<tr>
<td>Median</td>
<td>8.282</td>
<td>-0.653</td>
<td>2.204</td>
<td>4.174</td>
<td>1.437</td>
<td>4.635</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.042</td>
<td>0.536</td>
<td>0.783</td>
<td>1.083</td>
<td>0.716</td>
<td>1.07</td>
</tr>
<tr>
<td>Coefficient of Variation</td>
<td>0.042</td>
<td>0.536</td>
<td>0.783</td>
<td>1.083</td>
<td>0.716</td>
<td>1.07</td>
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** - No transformation is needed (the raw data is already normally distributed)
none - The normality of the distribution cannot be improved.

Note: Standard Deviation = square root of variance
Coefficient of Variation = Standard Deviation / Mean

** = square root and removal of outliers
none = square root and removal of outliers only

Table 4: Summary of Financial Ratio Distribution:

- Variance and skewness are used to detect outliers.
- The raw data is already normally distributed.
- The distribution cannot be improved.

** - No transformation is needed (the raw data is already normally distributed)
none - The normality of the distribution cannot be improved.

Table 5: Distribution Characteristics for Operating Margin (%)

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none - The normality of the distribution cannot be improved.

Note: Standard Deviation = square root of variance
Coefficient of Variation = Standard Deviation / Mean

** = square root and removal of outliers
none = square root and removal of outliers only

Table 6: Summary of Financial Ratio Distribution:

- Variance and skewness are used to detect outliers.
- The raw data is already normally distributed.
- The distribution cannot be improved.

** - No transformation is needed (the raw data is already normally distributed)
none - The normality of the distribution cannot be improved.

Table 7: Distribution Characteristics for Operating Margin (%)

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</thead>
<tbody>
<tr>
<td>Median</td>
<td>8.282</td>
<td>-0.653</td>
<td>2.204</td>
<td>4.174</td>
<td>1.437</td>
<td>4.635</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.042</td>
<td>0.536</td>
<td>0.783</td>
<td>1.083</td>
<td>0.716</td>
<td>1.07</td>
</tr>
<tr>
<td>Coefficient of Variation</td>
<td>0.042</td>
<td>0.536</td>
<td>0.783</td>
<td>1.083</td>
<td>0.716</td>
<td>1.07</td>
</tr>
</tbody>
</table>

** - No transformation is needed (the raw data is already normally distributed)
none - The normality of the distribution cannot be improved.

Note: Standard Deviation = square root of variance
Coefficient of Variation = Standard Deviation / Mean

** = square root and removal of outliers
none = square root and removal of outliers only

Table 8: Summary of Financial Ratio Distribution:

- Variance and skewness are used to detect outliers.
- The raw data is already normally distributed.
- The distribution cannot be improved.

** - No transformation is needed (the raw data is already normally distributed)
none - The normality of the distribution cannot be improved.
The results for debt to equity for both industries across time are shown in Table 4. As reported in the table, the P-value for W and D test statistics indicate that the null hypothesis of normality is rejected for all the distributions across years. However, the distributions' normality was improved after undergoing the process of transformation. The distributions for both industries across years are positively skewed but an overwhelming kurtosis value can be observed for the manufacturing industry in 1990 (27.36) and 1991 (37.75). These overwhelming values indicate that the data is concentrated more towards the mean value. In other words, the debt to equity ratios for all companies across time is homogeneous for both industries across time were close to normal distribution.

### Table 4
Distribution Characteristics for Debt to Equity

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</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.633</td>
<td>0.456</td>
<td>0.584</td>
<td>0.584</td>
<td>0.530</td>
<td>0.75</td>
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<td>0.73</td>
<td>0.613</td>
<td>0.566</td>
<td>0.637</td>
<td>0.790</td>
<td>0.85</td>
</tr>
<tr>
<td>Skewness</td>
<td>4.041</td>
<td>1.521</td>
<td>5.689</td>
<td>2.382</td>
<td>1.170</td>
<td>2.787</td>
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<tr>
<td></td>
<td>6.601</td>
<td>1.894</td>
<td>1.682</td>
<td>1.741</td>
<td>2.219</td>
<td>1.35</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>27.36</td>
<td>1.444</td>
<td>37.75</td>
<td>5.753</td>
<td>3.270</td>
<td>8.712</td>
</tr>
<tr>
<td></td>
<td>51.712</td>
<td>4.140</td>
<td>2.978</td>
<td>3.115</td>
<td>5.750</td>
<td>1.30</td>
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<tr>
<td>Std Dev</td>
<td>1.155</td>
<td>0.546</td>
<td>1.184</td>
<td>0.832</td>
<td>0.580</td>
<td>1.066</td>
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<td></td>
<td>1.519</td>
<td>0.899</td>
<td>0.606</td>
<td>0.726</td>
<td>0.940</td>
<td>0.62</td>
</tr>
<tr>
<td>C.V (%)</td>
<td>1.826</td>
<td>1.167</td>
<td>2.027</td>
<td>1.425</td>
<td>1.994</td>
<td>1.421</td>
</tr>
<tr>
<td></td>
<td>1.14</td>
<td>1.372</td>
<td>1.14</td>
<td>1.117</td>
<td>1.117</td>
<td>1.14</td>
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<tr>
<td>Transformation ln</td>
<td>ln</td>
<td>ln*</td>
<td>ln</td>
<td>ln</td>
<td>ln</td>
<td>ln</td>
</tr>
<tr>
<td>n</td>
<td>67</td>
<td>21</td>
<td>61</td>
<td>27</td>
<td>95</td>
<td>29</td>
</tr>
<tr>
<td>D-Stat</td>
<td>0.242</td>
<td>0.311</td>
<td>0.18</td>
<td>0.015</td>
<td>0.175</td>
<td>0.199</td>
</tr>
<tr>
<td>W-Stat</td>
<td>0.773</td>
<td>0.717</td>
<td>0.66</td>
<td>0.794</td>
<td>0.799</td>
<td>0.799</td>
</tr>
<tr>
<td>Prob &lt; WID</td>
<td>0.000</td>
<td>&lt;0.01</td>
<td>0.000</td>
<td>&lt;0.01</td>
<td>0.000</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

- square = square root
- ln = Lognormal
- ln* = Lognormal and removal of outliers
- square* = square root and removal of outliers
- ** = No transformation is needed (the raw data is already normally distributed)
- ** = The normality of the distribution cannot be improved.

Std Dev = Standard Deviations
C.V (%) = Coefficient of variation
manu = manufacturing
1 = D-Stat, W-Stat and Prob < WID are values referring to the raw data
Current ratio distribution characteristics are shown in Table 5. The distributions for both industries were skewed to the right and it is also observed that the manufacturing companies’ distributions are skewed compared to the distributions of companies in the financial services industry. Positive kurtosis values were seen mostly for distributions in the manufacturing industry, with the highest value in 1995 (97.550). This high value indicates that the distribution departs from the normal distribution in which the kurtosis should be 0. This phenomenon also shows that the current ratio in manufacturing companies is distributed near to the mean value. Except for the distributions in the financial services industry in 1992, all the distributions were close to normal after being transformed and outliers removed.

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</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1.726</td>
<td>1.813</td>
<td>1.522</td>
<td>1.156</td>
<td>1.811</td>
<td>1.253</td>
<td>1.783</td>
<td>1.472</td>
<td>1.868</td>
<td>1.883</td>
<td>1.910</td>
<td>1.219</td>
</tr>
<tr>
<td>1993</td>
<td>1.645</td>
<td>1.579</td>
<td>0.728</td>
<td>0.745</td>
<td>2.692</td>
<td>1.286</td>
<td>1.892</td>
<td>1.710</td>
<td>25.650</td>
<td>4.812</td>
<td>3.070</td>
<td>1.699</td>
</tr>
<tr>
<td>1994</td>
<td>1.642</td>
<td>0.978</td>
<td>0.685</td>
<td>0.643</td>
<td>1.382</td>
<td>1.034</td>
<td>1.117</td>
<td>1.162</td>
<td>1.071</td>
<td>2.595</td>
<td>1.189</td>
<td>1.36</td>
</tr>
<tr>
<td>1995</td>
<td>77</td>
<td>21</td>
<td>76</td>
<td>27</td>
<td>110</td>
<td>29</td>
<td>114</td>
<td>30</td>
<td>102</td>
<td>31</td>
<td>122</td>
<td>41</td>
</tr>
</tbody>
</table>

** = No transformation is needed (the raw data is already normally distributed)
none = The normality of the distribution cannot be improved.
Overwhelming values of kurtosis were also shown for cash ratio distribution especially for the manufacturing industry across the years (Table 6). The highest value of kurtosis is in 1995 for the manufacturing industry (113.50). The raw data distribution was not normally distributed but after being transformed, the distribution is close to normal. The interesting part is that all the distributions achieved normality by transforming the data to natural log. It can also be observed that all the distributions are positively skewed.

Table 6
Distribution Characteristics for Cash Ratio

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</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.478</td>
<td>0.342</td>
<td>0.381</td>
<td>0.500</td>
<td>1.278</td>
<td>0.383</td>
</tr>
<tr>
<td>Std Dev</td>
<td>1.246</td>
<td>0.329</td>
<td>0.555</td>
<td>0.403</td>
<td>7.859</td>
<td>0.769</td>
</tr>
<tr>
<td>C.V (%)</td>
<td>2.618</td>
<td>0.962</td>
<td>1.877</td>
<td>1.313</td>
<td>2.927</td>
<td>2.038</td>
</tr>
<tr>
<td>Transformation</td>
<td>ln</td>
<td>ln</td>
<td>ln</td>
<td>ln</td>
<td>ln</td>
<td>ln</td>
</tr>
<tr>
<td>D-Stat</td>
<td>0.361</td>
<td>0.275</td>
<td>0.433</td>
<td>0.388</td>
<td>1.144</td>
<td>0.414</td>
</tr>
<tr>
<td>W-Stat</td>
<td>0.843</td>
<td>0.696</td>
<td>0.431</td>
<td>0.431</td>
<td>0.431</td>
<td>0.431</td>
</tr>
<tr>
<td>Prob &lt; W/D</td>
<td>0.000</td>
<td>&lt; 0.01</td>
<td>0.000</td>
<td>&lt; 0.01</td>
<td>0.000</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

- square = square root
- ln = Lognormal
- ln* = Lognormal and removal of outliers
- square* = square root and removal of outliers
- *** = Removal of outliers only

Std Dev = Standard Deviations  
C.V (%) = Coefficient of variation  
Menu = manufacturing  
1 = D-Stat, W-Stat and Prob < W/D are values referring to the raw data

** = No transformation is needed (the raw data is already normally distributed)  
none = The normality of the distribution cannot be improved.
Inspections of the asset turnover distribution characteristics are reported in Table 7. Some of the distributions still exhibit non-normality although the data was transformed and outliers were removed. The distributions were also positively skewed and the kurtosis for the financial services industry is generally higher than in the manufacturing industry.

Table 7
Distribution Characteristics for Asset Turnover

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<tbody>
<tr>
<td>Manu</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Financial</td>
<td>0.612</td>
<td>0.474</td>
<td>1.156</td>
<td>0.362</td>
<td>1.033</td>
<td>0.373</td>
</tr>
<tr>
<td>Manu</td>
<td>0.553</td>
<td>3.944</td>
<td>2.410</td>
<td>3.597</td>
<td>1.464</td>
<td>2.400</td>
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<tr>
<td>Mean</td>
<td>5.648</td>
<td>0.768</td>
<td>0.708</td>
<td>0.496</td>
<td>0.611</td>
<td>0.443</td>
</tr>
<tr>
<td>Std</td>
<td>1.566</td>
<td>1.816</td>
<td>0.616</td>
<td>1.367</td>
<td>0.589</td>
<td>1.188</td>
</tr>
<tr>
<td>Skew</td>
<td>**</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Kurt</td>
<td>**</td>
<td>**</td>
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<td>**</td>
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</tr>
</tbody>
</table>

Note: ** = no transformation is needed (the raw data is already normally distributed)
\( < \) = The normality of the distribution cannot be improved.

Table Tolerant Measures (W/D) = Tolerant measures of asset turnover:
- W = Winsorized
- D = Deleted

Table 7 - Standard Deviations

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</tr>
<tr>
<td>Financial</td>
<td>0.24</td>
<td>0.588</td>
<td>0.000</td>
<td>&lt;0.01</td>
<td>0.000</td>
<td>&lt;0.01</td>
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Note: ** = no transformation is needed (the raw data is already normally distributed)
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Table 7 - Coefficient of Variation

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<td>Financial</td>
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<td>0.144</td>
<td>0.135</td>
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<td>0.137</td>
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Table 7 - Summary Measures (W/D) = Summary measures of asset turnover:
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Table 7 - Outliers (W/D) = Outliers of asset turnover:
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DISCUSSION

Based on the analysis of the financial ratios for the year 1990-1995 I have shown that the assumption of normality is not true for raw data other than for several ratios from the financial services industry. As for manufacturing companies, all the financial ratios were not normally distributed.

High values of coefficient of variation supported the result of non-normality. According to Horrigan (1965) wide dispersion in financial ratios distribution would make it difficult to obtain a distinctive average ratio and therefore it is impossible to discriminate between companies on the basis of ratios. Among the factors that are expected to increase the dispersion of financial ratios are industry classifications, size of firm, cyclical conditions, seasonal conditions, geographical location and accounting method. This factor will cause the sample to be non-homogeneous. Lee (1988) claimed that homogeneity of cross-sectional data is an important property in testing the normality of a distribution.

The sample statistics also revealed the non-normality of the financial ratios distribution. The study showed that all the financial ratios for manufacturing companies were skewed to the right (positive skewness). The result is commensurate with the findings by Horrigan (1965). He mentioned that the positive skewness seems reasonable since most of these ratios have an effective lower limit of zero and indefinite upper limit.

It was noticed, however, that natural log and square root transformation give a better approximation to normality. Overall, transformed data exhibited lower skewness compared with raw data. However, some ratios after removal of outliers, show an increase in normality. Although most of the ratios exhibit distribution close to normal after being transformed and undergoing the techniques of removing the outliers, there are some ratios especially in financial services companies, which do not see an improvement in normality. This implies that the existence of extreme values is not the only factor of non-normality. So (1987) claimed that the non-homogeneous characteristics and the non-proportions behaviour make it difficult, if not impossible, to identify outliers. As a result, it explains why normality is not obtained using outlier’s eliminating technique.

CONCLUSION

In conclusion, since most of the financial ratios analysed showed significant non-normality, financial analysis using ratios, such as industry average ratios as a ‘benchmark’ for performance evaluation must take into consideration the skewness and non-normality. Otherwise, conclusions may be misleading. This is due to the fact that the average value, which is usually an arithmetic mean, is not
suitable measure of central tendency since it is influenced by extreme values. According to Levin and Ritzman (1994), weighted average is the preferable measure to replace arithmetic mean when non-normality exists. They also mentioned that inability to reject the null hypothesis indicate that non-parametric statistical test is not an advisable tool to analyse financial ratios. Non-parametric statistical test is a better approach since the test does not require the normality assumption. Among the suitable non-parametric test are Mann Whitney-U, Kruskall-Wallis, and Spearman Rank Correlation. However, the parametric test can be used if the distribution exhibits normality after the data is transformed and outliers are removed or both.

Although variation or differences occur between the industrial average and financial ratios of a particular company (if industrial average is the right measure to be a benchmark) this does not imply that the company is not financially stable. Variation may exist due to the difference in corporate objectives.
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