An investigation into the normality of the distributions of financial ratios of listed South African industrial companies

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In this article we examine some of the inter-temporal and cross-sectional distributional properties of a selected number of financial ratios of South African industrial companies and we evaluate the effect of a simple procedure of outlier rejection. The normality assumption is rejected consistently in the case of the industry analysis and frequently in the sectoral and yearly analyses.

In dié artikel word sommige van die intertemporale en deursnee verdelingseienskappe van 'n geselekteerde aantal finansiële verhoudings van Suid-Afrikaanse nywerheidsmaatskappye ontleed en die resultaat van 'n eenvoudige metode van uitskieterverwydering word geëvalueer. Die normaliteitsaannames word konsekwent op industriële vlak en dikwels op sektorale en jaarvlak verwerp.

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Introduction

Financial ratios are used for various purposes, such as corporate failure prediction, bond rating, security analysis, commercial credit rating, the estimation of accounting-based measures of risk and the investigation into differences in accounting practices by different companies (Ezzamel, Brodie & Mar-Molinero, 1987). Most of these applications employ parametric statistical procedures of which the validity partly depends on the underlying distributional properties of the ratios. Barnes (1987: 451) and Foster (1986: 101–102) stress the importance of knowledge about the distributional properties of financial ratios. First, it is required in order to use the ratios themselves in controlling for the effect of size on the financial variables under analysis or to control for industry-wide factors. A financial institution, for example, before lending money, may wish to determine where on the industry distribution a loan applicant's ratio falls or a corporation may wish to determine the upside potential of a decision to move a particular financial ratio of a business unit into the ninth industry decile. In financial research knowledge of distributions may lead to more optimal decisions of sample size in studies aimed at estimating the financial characteristics of a population. Second, closely connected to the first argument, an examination of the distributions will indicate whether the ratio distribution can be characterized by only two parameters, the mean and standard deviation, as is practise when a normal distribution is assumed. Should the normal distribution be used to estimate risk in a situation where the underlying distribution displays strong kurtosis, the use of the standard deviation may lead to serious underestimation of the risk involved. Third, a number of statistical techniques used in financial analysis assume multivariate normality. Such models, however, are sensitive to the presence of skewed data. For example, standard discriminant analysis procedures assume that the variables used to describe or characterize the members of the different groups are multivariate normally distributed. Violation of this assumption may bias tests of significance and the estimated error rates (Eisenbeis, 1977). In regression analysis the distribution of the variables affect the assumption of errors that are NID $(0, \sigma^2)$. If the assumption is violated, it prevents an assessment of the statistical reliability of the coefficient estimates using the classical t- or F-tests. An examination of the distributional patterns of financial ratios will caution against the injudicious application of these models. In the fourth place, evidence on distributional properties may provide a stimulus to subsequent research which may promote better understanding of the empirical regularities and/or irregularities in financial statement data.

It is clear from the above arguments that the normal distribution plays an important role in financial statement analysis. However, despite the attractions of working with the normal distribution, reasons exist for expecting non-normality in a number of ratios. Barnes (1982) has shown that asymmetry will result from lack of proportionality between the numerator and denominator in a financial ratio. Some financial ratios have technical limits (e.g. a lower limit of zero and/or an upper limit of 100%) which will prevent literal normality, or economic limits may result in fewer tail-end observations that would be expected under the normal.

This article is aimed at investigating the normality assumption for the financial ratios of listed South African industrial companies over the period 1970 to 1992. The remainder of this article is organized as follows. A second section contains a brief summary of a literature survey while in a third section the research method is outlined. A fourth section contains the results and a final section the conclusions.

Literature survey

Internationally a substantial amount of research has been done to determine whether the distributions of financial ratios conform to the normality assumption. In general it has been found that few ratios are normally distributed. Further attempts have been made to evaluate normality after the data were screened for outliers (extreme values) and also after the data have been transformed using logarithmic, square root and cubic adjustments in an effort to obtain normality.

Further issues such as the impact of year-end dates and sample sizes have also been investigated.

In an early study of the United States manufacturing sector Horrigan (1965) reported distributions which tended to be approximately normal, but with some evidence of positive skewness. In contrast, Deakin (1976) concluded that in the United States manufacturing sector, out of eleven ratios tested, ten were significantly different from a normal distribution and that only the total debt/total assets ratio was normally distributed.

In testing for the normality of financial ratios in Australia, Bird & McHugh (1977) concluded that financial leverage and efficiency ratios were generally normally distributed, but that ratios related to quick assets and asset structure in general were not. A study on the distributional properties of financial ratios in the United Kingdom conducted in 1976 by Bougen & Drury (1980) indicated that the ratios tended not to be normally distributed. Frecka & Hopwood (1983), in investigating United States manufacturing companies from 1950 to 1979, found that in most cases, when outliers were removed from distributions close to normal, normality was achieved. However, in the case of raw data, normality was rejected. Buijink & Jegers (1986), in a Belgian study over the period 1977 to 1981, could not conclusively accept or reject normality. So (1987) also rejected, for United States companies, the assumption of normality.

Ezzamel, Mar-Molinero & Beecher (1987) argued that three common observations had emerged from the literature. First, all studies pointed towards positive skewness in the distributions of the ratios. This might be attributed to an effective lower limit of zero, but an indefinite upper limit for most ratios. Second, those ratios which considerably departed from normality, were characterized by the presence of extreme outliers. Third, they observed that raw data transformation tended to improve approximations to normality, but did not solve the outlier problem. In a subsequent article Ezzamel & Mar-Molinero (1990) could not find support for the assumption of normality in the distributions of nine financial ratios examined for United Kingdom data.

In a recent preliminary South African study, using the same nine ratios as Ezzamel & Mar-Molinero (1990), Muil, Hamman & Smit (1992) concluded that as regards skewness, industry ratios showed a tendency to be positively skewed in all but the case of the total debt/total assets ratio which was negatively skewed. These results carried through to the sectoral level. Concerning kurtosis, it was concluded that on both the industrial and sectoral level, outlier removal had a tendency to improve the standardized coefficients of kurtosis to within the typical normal range in most of the ratios examined. Very little evidence of normality could be found using the raw data set, but outlier rejection tended to improve the situation.

The current research is an extension of the previous work in so far as 27 ratios, rather than the initial nine ratios, are examined; the sample is differently constituted; and the time frame is extended to the period 1970 to 1992 compared to the 1980 to 1989 period which was utilized in the 1992 research.

Research method

The present study is conducted on 27 financial ratios (see Table 1) of listed South African industrial companies over

Table 1 Description of ratios

Ratio number	Ratio description	Abbreviations	Bounds
1	Current assets/current liabilities	CUR	0 to ∞
2	Current assets*100/total assets	CA/TA	0 to 100
3	Stock*100/total assets	STOCK/TA	0 to 100
4	Debtors*100/total assets	DEB/TA	0 to 100
5	Current liabilities*100/total assets	CL/TA	0 to 100
6	Creditors*100/total assets	CRED/TA	0 to 100
7	Stock*365/sales	STOCK365	0 to ∞
8	Debtors*365/sales	DEB365	0 to ∞
9	Creditors*365/sales	CRD365	0 to ∞
10	Sales/total assets	SA/TA	Small to ∞
11	Long-term debt*100/total assets	LTD/TA	0 to 100
12	Ordinary equity*100/total assets	EQ/TA	0 to 100
13	Interest bearing debt*100/total assets	IB/TA	0 to 100
14	Total debt*100/total assets	TD/TA	0 to 100
15	(Total debt+prefs)*100/total assets	DP/TA	0 to 100
16	Ordinary equity*100/long-term debt	EQ/LTD	Unbounded
17	Long-term debt*100/ordinary equity	LTD/EQ	0 to ∞
18	Total debt*100/ordinary equity	D/E	Unbounded
19	Ordinary equity*100/total debt	E/D	Unbounded
20	EBIT/interest paid (interest cover)	IC	Unbounded
21	Dividend cover	DC	Unbounded
22	Profit before taxation*100/sales	PBT/SA	Unbounded
23	Profit after taxation*100/sales	PAT/SA	Unbounded
24	Profit after taxation*100/total assets	PAT/TA	Unbounded
25	EBIT*100/total assets	EBIT/TA	Unbounded
26	Return on equity	ROE	Unbounded
27	EBIT*100/sales	EBIT/SA	Unbounded

Notes

Total assets	=	Fixed assets (excluding intangible assets) + other assets + current assets
Total debt	=	Long-term debt (excluding deferred taxation) + current liabilities
Equity	=	Shareholders' interest (excluding intangible assets)
Prefs	=	Preference share capital
EBIT	=	Profit before taxation + interest paid
ROE	=	(Profit after taxation — preference dividends — minority interest in profits) *100/Equity

the period 1970 to 1992. The chosen ratios cover six major ratio analysis components namely liquidity (one ratio), working capital composition (five ratios), activity (four ratios), debt (nine ratios), coverage (two ratios), and profitability (six ratios).

The raw financial data from the listed companies' annual reports were extracted from the University of Stellenbosch Business School Data Base and transformed into the financial ratios for each company for each year. To be included in the sample a company must have published a 1991 annual report and still have been listed at the end of 1992. Only those companies for which 1992 reports were available at the time of analysis were included in the study in respect of 1992. For each company included in the study the ratios pertaining to the first year of inclusion were deleted, because it could not be ascertained from the data base whether the results pertained to a full financial year. Also all investment holding companies and pyramid companies, of which the sole or main asset is an investment(s) in other listed South African companies, were deleted to preclude possible atypical patterns in the financial ratios. Non-South African companies were also deleted on the assumption that they may operate in different types of markets.

Next, extreme values were considered. The approach used was to delete outliers beyond three standard deviations from the mean. No judgement was exercised in removing outliers.

This approach is contrary to Buijink & Jegers' (1986: 343) referral to Bougen & Drury's (1980) use of judgement and their view that removing outliers beyond three standard deviations was contrary to the fundamental proof of normality being sought, since the outliers would directly impact on the normality test. This critique was heeded and both the raw data and data after outlier removal were tested for normality. The present approach is also contrary to that of Ezzamel & Mar-Molinero (1990) who used the three standard deviation procedure, but also exercised judgement in rejecting outliers.

The current approach was used because a high premium was placed on objectivity in handling the data. The resulting sample sizes before and after outlier rejection are shown in Table 2. The key to the sector codes can be found in the Appendix.

The analysis of the data is done on three levels:

— all data are combined and the assumption of normality for each of the ratios tested over all sectors and over all time periods (referred to as the industry level);

— the ratios for the full period are divided into sectors and the results in the respective sectors are aggregated over time (the sectoral level); and

— the ratios are analyzed per year while aggregated over sectors (the yearly level).

Insufficient observations precluded the analysis of the ratios per sector per year.

Finally the results are tabulated and presented as the percentage of ratio distributions where the assumption of normality could not be rejected. This makes the results comparable to the international evidence cited above.

The statistical analysis relies heavily on the computation

Table 2 Average sample sizes

		Raw data	After outlier rejection
(a) Industry		3203	3167
(b) Sectors			
	15	509	503
	21	98	96
	22	260	257
	23	88	87
	24	286	283
	25	160	157
	26	68	67
	27	137	135
	28	263	260
	29	282	279
	30	149	147
	31	186	184
	32	74	74
	33	82	81
	34	29	29
	35	66	65
	36	311	308
	37	43	43
	38	54	53
	39	59	59
(c) Years			
	1970	37	36
	1971	90	89
	1972	95	94
	1973	105	104
	1974	106	105
	1975	108	107
	1976	111	109
	1977	111	109
	1978	112	111
	1979	114	112
	1980	120	118
	1981	117	116
	1982	129	127
	1983	131	129
	1984	129	127
	1985	131	129
	1986	135	133
	1987	147	144
	1988	191	188
	1989	259	256
	1990	281	278
	1991	288	285
	1992	156	154

of standardized coefficients of skewness and kurtosis and batteries of tests for normality. Standardized coefficients of skewness and kurtosis are used as descriptive measures. A standardized coefficient of skewness or kurtosis outside the range -2 to $+2$ indicates significant departure from a normal distribution. Two tests are used to test for normality, namely the chi-square goodness-of-fit test and the Kolmogorov-

Smirnov (K-S) test. The Kolmogorov-Smirnov test is preferred over the chi-square test if the sample size is small. While there is controversy over which test is more powerful, the general feeling seems to be that the K-S test is probably more powerful than the chi-square test in most situations (Conover, 1971: 295). This conclusion, however, is not

Table 3a Statistical summary: industry level

(a) Raw data

| Category | Liquidity | Working capital composition | | | | | Activity | | | |
Ratio	CUR	CA/TA	STOCK/TA	DEB/TA	CL/TA	CRED/TA	STOCK365	DEB365	CRD365	SA/TA
Mean	1.88	60.81	26.58	27.49	38.71	23.38	61.84	71.18	56.75	1.71
Median	1.57	61.99	26.11	25.95	37.29	20.97	58.65	63.25	52.21	1.54
Mode	1.47	54.40	0.00	0.00	36.45	19.44	0.00	59.56	55.46	1.61
Standard deviation	4.11	20.54	15.59	15.80	16.77	13.54	37.21	58.73	29.35	1.01
Minimum	0.01	0.18	0.00	0.00	0.21	0.03	0.00	0.00	1.00	0.10
Maximum	221.00	99.87	87.88	94.56	196.25	112.19	520.06	926.73	453.07	12.36
Standardized skewness	1092.49	-11.83	8.19	24.54	18.75	26.23	47.31	105.99	76.93	52.20
Standardized kurtosis	2866.69	-2.23	-1485.00	22.10	37.86	23.53	190.72	457.48	339.92	119.69
P-value (chi-square)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-value (K-S)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3b Statistical summary: industry level

(a) Raw data

| Category | Debt | | | | | | | | |
Ratio	LTD/TA	EQ/TA	IB/TA	TD/TA	DP/TA	EQ/LTD	LTD/EQ	D/E	E/D
Mean	10.05	44.20	20.08	48.67	50.17	2244.67	57.68	222.04	163.92
Median	7.87	43.43	18.82	48.84	50.24	361.14	18.41	113.50	87.03
Mode	0.00	42.06	0.00	50.47	45.92	0.00	0.00	86.31	115.86
Standard deviation	9.99	19.40	14.73	18.19	18.99	12577.36	1627.38	4596.59	855.80
Minimum	0.00	-188.51	0.00	0.21	0.21	-2042.20	-5018.75	-67135.71	-254.15
Maximum	86.94	99.79	164.70	201.23	288.31	304697.22	94380.00	253669.38	47200.00
Standardized skewness	43.22	-22.35	32.77	15.68	32.96	361.77	1368.86	1163.64	1173.76
Standardized kurtosis	74.65	120.57	76.10	61.29	149.97	3395.34	39687.00	32695.41	32095.94
P-value (chi-square)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-value (K-S)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3c Statistical summary: industry level

(a) Raw data

| Category | Coverage | | Profitability | | | | | |
Ratio	IC	DC	PBT/SA	PAT/SA	PAT/TA	EBIT/TA	ROE	EBIT/SA
Mean	38.63	2.61	9.63	6.21	8.05	15.64	10.45	11.88
Median	5.56	2.42	8.05	5.19	7.88	14.73	16.79	10.24
Mode	0.00	0.00	8.84	3.99	6.21	13.79	15.34	8.11
Standard deviation	243.81	3.75	9.85	7.39	8.75	10.87	685.89	10.01
Minimum	-60.00	-58.81	-82.39	-81.38	-147.56	-144.82	-36298.30	-63.43
Maximum	5675.00	82.22	114.23	111.88	123.04	144.09	14832.14	144.80
Standardized skewness	329.26	109.80	35.31	38.36	-21.96	29.90	-972.97	62.01
Standardized kurtosis	279.55	2059.16	180.73	400.24	1069.45	548.51	28392.60	306.40
P-value (chi-square)	0.00	0.00	0.00	0.00	0.00	0.00	DOF	0.00
P-value (K-S)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: DOF = insufficient degrees of freedom

borne out by the current research.

Results

The statistical results at industry level are presented in Table 3. Using both the chi-square test and the Kolmogorov-Smir-

nov test, the null hypothesis of normality is rejected in all cases at the 2% level of significance (and even lower levels). *Financial ratios, aggregated over time and over sectors, are clearly not normally distributed, both before and after outlier removal.*

Table 3d Statistical summary: industry level

(b) After outlier removal

Category	Liquidity	Working capital composition					Activity			
Ratio	CUR	CA/TA	STOCK/TA	DEB/TA	CL/TA	CRED/TA	STOCK365	DEB365	CRD365	SA/TA
Mean	1.76	60.81	26.31	26.38	38.43	22.73	60.00	64.37	54.89	1.61
Median	1.57	61.99	25.99	25.67	37.22	20.77	58.27	62.63	51.90	1.53
Mode	1.47	54.40	0.00	0.00	36.45	19.44	0.00	59.56	55.46	1.61
Standard deviation	1.00	20.54	15.16	13.89	16.07	12.38	31.50	34.37	22.65	0.78
Minimum	0.01	0.18	0.00	0.00	0.21	0.03	0.00	0.00	1.00	0.10
Maximum	13.24	99.87	70.20	74.33	88.26	63.80	168.34	244.24	144.38	4.73
Standardized skewness	111.72	-11.83	4.90	12.88	8.73	17.58	7.08	29.55	16.63	25.12
Standardized kurtosis	399.36	-2.23	-5.11	5.34	0.37	54.46	1.06	47.45	10.37	22.87
P-value (chi-square)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-value (K-S)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00

Table 3e Statistical summary: industry level

(b) After outlier removal

Category	Debt								
Ratio	LTD/TA	EQ/TA	IB/TA	TD/TA	DP/TA	EQ/LTD	LTD/EQ	D/E	E/D
Mean	9.45	44.68	19.48	48.35	49.61	1249.63	31.23	153.33	143.44
Median	7.70	43.54	18.72	48.82	50.02	357.63	18.41	113.49	86.77
Mode	0.00	42.06	0.00	50.47	45.92	0.00	0.00	86.31	115.86
Standard deviation	8.59	17.78	13.27	16.95	17.08	3270.94	68.91	364.42	227.00
Minimum	0.00	-11.94	0.00	0.21	0.21	-2042.20	-648.58	-6145.83	-254.15
Maximum	39.62	99.79	63.67	101.65	104.51	39964.24	1382.67	12512.58	2565.66
Standardized skewness	22.28	7.59	11.57	-4.28	-1.80	144.00	187.45	285.02	138.10
Standardized kurtosis	4.61	1.53	-2.92	0.47	1.01	551.56	1447.58	5394.35	509.99
P-value (chi-square)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-value (K-S)	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00

Table 3f Statistical summary: industry level

(b) After outlier removal

Category	Coverage		Profitability					
Ratio	IC	DC	PBT/SA	PAT/SA	PAT/TA	EBIT/TA	ROE	EBIT/SA
Mean	18.34	2.48	9.80	5.89	8.05	15.29	17.72	11.26
Median	5.53	2.41	8.32	5.15	7.88	14.68	16.79	10.15
Mode	0.00	0.00	8.84	3.99	6.21	13.79	15.34	8.11
Standard deviation	57.78	1.58	6.71	5.12	5.50	7.56	35.72	7.27
Minimum	-60.00	-8.27	-0.17	-13.21	-17.46	-16.32	-902.29	-14.95
Maximum	765.67	13.41	39.03	28.30	34.14	46.92	610.68	40.69
Standardized skewness	180.45	18.84	27.20	17.00	1.38	6.75	-97.92	19.79
Standardized kurtosis	820.31	73.36	23.37	31.29	31.56	15.57	2433.56	21.70
P-value (chi-square)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-value (K-S)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The majority of ratios, in raw data format, tend to be positively skewed. The exceptions are the CA/TA, EQ/TA, PAT/TA and ROE ratios. After removal of the outliers EQ/TA and PAT/TA also become positively skewed, but TD/TA and DP/TA tend towards negative symmetry. Standardized kurtosis coefficients tend to be positive, indicating heavier tails than can be expected under a normal assumption. Outlier removal alleviates this problem to a certain degree. However, a similar effect on skewness is not noticeable.

The lack of normality may be explained, amongst others, by non-homogeneities introduced via the aggregation of sectors and/or time. To investigate the effect of sectors, the data were disaggregated and the tests applied to each sector after aggregation over time. The percentages of the sectors where normality could not be rejected at the 5% level of significance are presented in Table 4. If one uses the chi-square test as norm, the percentages where normality could not be rejected, vary from 0% in the case of interest cover to 45% in the cases of the CL/TA and SA/TA ratios. Using the Kolmogorov-Smirnov test, these percentages vary between 0% in the case of interest cover to 80% in the case of the CL/TA and the DP/TA ratio. Outlier removal is beneficial to normality as most of the percentages increase. In not a single instance could IC and EQ/LTD be shown to be

normally distributed, while the CL/TA, SA/TA, PBT/SA, PAT/TA, EBIT/TA and EBIT/SA will less frequently violate the assumption of normality when analysis takes place on sectoral level. The overall conclusion, however, is clear: aggregating ratios over sectors has the effect of introducing non-homogeneities which mitigate against normality in the ratio distributions of the aggregated data.

To investigate the effect of aggregation over time, the data were disaggregated and the tests applied per year after aggregation over sectors. The percentages of the years when normality could not be rejected at the 5% level of significance are presented in Table 5. Here the evidence of normality is much stronger than it had been in the case of a sectoral breakdown. If one uses the chi-square test as norm, the percentages where normality could not be rejected, vary from 0% in the case of CUR, LTD/TA, EQ/LTD, LTD/EQ, D/E, E/D, IC, PAT/SA and ROE to 87% in the case of the CL/TA ratio. Using the Kolmogorov-Smirnov test, these percentages vary between 0% in the case of CUR, EQ/LTD, LTD/EQ, D/E, E/D and IC to 100% for the STOCK/TA and CL/TA ratios. As before outlier removal is beneficial to normality. Also, as before, EQ/LTD and IC could not be shown to be normally distributed.

Table 4 Percentage of sectors where normality is not rejected ($\alpha = 0.05$)

Ratio No	Ratio Abbreviations	Raw data		Outliers removed	
		Chi-square	K-S	Chi-square	K-S
1	CUR	20	35	25	55
2	CA/TA	20	65	15	70
3	STOCK/TA	15	60	15	65
4	DEB/TA	15.8	55	30	55
5	CL/TA	45	80	50	85
6	CRED/TA	30	50	25	55
7	STOCK365	20	45	25	55
8	DEB365	15	50	25	65
9	CRED365	25	70	45	80
10	SA/TA	45	65	50	70
11	LTD/TA	5	35	15	45
12	EQ/TA	15	70	25	75
13	IB/TA	35	65	40	75
14	TD/TA	20	75	30	85
15	DP/TA	25	80	40	90
16	EQ/LTD	0	0	0	0
17	LTD/EQ	5	15	5	20
18	D/E	10	25	20	40
19	E/D	0	10	0	30
20	IC	0	0	0	0
21	DC	15	25	20	45
22	PBT/SA	25	65	50	75
23	PAT/SA	15.8	40	31.6	75
24	PAT/TA	20	35	47.4	95
25	EBIT/TA	36.8	60	60	95
26	ROE	10	20	30	40
27	EBIT/SA	15.8	55	40	75

Table 5 Percentage of years where normality is not rejected ($\alpha = 0.05$)

Ratio No	Ratio Abbreviations	Raw data		Outliers removed	
		Chi-square	K-S	Chi-square	K-S
1	CUR	0	0	8.7	43.5
2	CA/TA	69.6	87	73.9	87
3	STOCK/TA	65.2	100	60.9	100
4	DEB/TA	34.8	73.9	78.3	95.7
5	CL/TA	87	100	91.3	100
6	CRED/TA	17.4	65.2	47.8	87
7	STOCK365	68.2	87	81.8	95.7
8	DEB365	4.5	8.7	31.8	47.8
9	CRED365	22.7	56.5	63.6	91.3
10	SA/TA	8.7	26.1	34.8	47.8
11	LTD/TA	0	34.8	0	56.5
12	EQ/TA	73.9	95.7	82.6	100
13	IB/TA	26.1	82.6	30.4	87
14	TD/TA	56.5	95.7	69.6	100
15	DP/TA	73.9	95.7	87	100
16	EQ/LTD	0	0	0	0
17	LTD/EQ	0	0	0	17.4
18	D/E	0	0	0	34.8
19	E/D	0	0	0	4.3
20	IC	0	0	0	0
21	DC	8.7	13	17	47.8
22	PBT/SA	4.5	34.8	31.8	82.6
23	PAT/SA	0	26.1	30.4	78.3
24	PAT/TA	13	43.5	56.5	91.3
25	EBIT/TA	13	43.5	69.6	100
26	ROE	0	8.7	47.8	56.5
27	EBIT/SA	13	43.5	56.5	82.6

Summary and conclusion

In this article we have sought to examine some of the inter-temporal and cross-sectional distributional properties of financial ratios of South African industrial companies and to evaluate the effect of a simple procedure of outlier rejection namely removing data points further removed than three standard deviations from the mean.

The results of the tests revealed that the normality assumption was rejected consistently in the case of the industry analysis and frequently in the sectoral and yearly analyses. It was not possible to indicate conclusively whether this was due to the greater power of the test in the larger samples or because greater sample homogeneity improves approximation to normality. The extent of non-normality changed across sectors indicating possibly that sector specific characteristics impact on the properties of the distribution. The results of inter-temporal analysis suggest that normality is more often achieved when disaggregating over time.

If one has to advise a researcher or practitioner to whom an underlying normal distribution in a financial ratio is important, one would probably advise in the first place to disaggregate over time, as a second approach to disaggregate over sectors, but never to treat the industry as a pooled sample. The results sound a warning to anyone injudiciously assuming normality in the distribution of financial ratios, whether it be in academic research or in accounting practice.

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Appendix: Sectors included in the analysis

Sector code	Sector description
15	Industrial holding
21	Beverages, hotels and leisure
22	Building and construction
23	Chemicals and oils
24	Clothing, footwear and textiles
25	Food
26	Fishing
27	Furniture and household goods
28	Engineering
29	Electronics, electrical and battery
30	Motor
31	Paper and packaging
32	Pharmaceutical and medical
33	Printing and publishing
34	Steel and allied
35	Transportation
36	Retailers and wholesalers
37	Sugar
38	Development capital
39	Tobacco and match