IMPORTANCE OF BUSINESS CYCLES IN ACCOUNTING NUMBER DISTRIBUTIONS

Empirical Evidence with Finnish Data

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Summary

The purpose of this study is to analyse the cross-sectional distributions of twelve common financial ratios and to model the time-series behaviour of these ratios during different business cycles. The selected ratios represent four a priori ratio categories: liquidity, long-term solvency, profitability and efficiency of the firms. The analysis shows that all the ratios can be made normally distributed. Some are already normal in the raw data form (profitability ratios), while the rest are originally positively skewed and need a square-root transformation (liquidity ratios, solvency ratios, and efficiency ratios). Removal of some outliers is also typically needed; their existence is highly dependent on business cycles. Among efficiency ratios, a division of the sample into two sub-samples (according to industry classification) is needed to obtain the desired result. The discovery that it is possible to model the most important first moments of ratio distributions with a business cycle index as their explanator emphasises the importance of business cycles in ratio distributions.

Key words: Distributions of financial ratios; Transformations; Outliers.

1 Introduction

1.1 Background

The analysis and use of financial ratios is an increasingly important area of accounting research and practice. The parties requiring financial statement information are investors, managers, employees, lenders, customers, and government. The demand for such information derives from the need to improve decision making (see e.g. Foster 1986, p. 9). Two principal uses of financial ratios can be identified. The first is the normative use of the measurement of a firm's financial ratio compared with a given standard, e.g. the need for a firm to use industry-wide averages as a target. In this context the selection of appropriate ratios should be based on both theoretical and empirical knowledge of individual financial ratios. In addition, knowledge on how to create these standards, e.g. how to aggregate industry-wide averages of the financial ratios, seems to be critical. The second principal use of financial ratios is the positive use of the ratios for predictive purposes e.g. by financial analysts to forecast future financial ratios, by lending institutions to forecast corporate failure, or by management to forecast cash flow or earnings (Whittington 1980, and Barnes 1987).

The main reasons for using financial ratios over absolute values are: first, to control the systematic effect of size on the variables; second, to make the data better satisfy the assumptions underlying some multivariate econometric methods (e.g. homoscedastic disturbances); and third, when the theory presupposes the empirical variables to be in the ratio form.

When using financial ratios, it is important to understand both the assumptions underlying the ratio form with different contents and also the empirical properties of the numerical values of those ratios (see Foster 1986, p. 96-130). In recent years a series of papers concerning methodological issues of financial ratios has been published. An important assumption in financial ratio analysis is the strict proportionality between numerator and denominator (Foster 1986, p. 96-98). Another interesting question is the existence (or non-existence) of the constant term in computing ratios (McDonald and Morris 1984, p. 90 and Yli-Olli and Virtanen 1985, p. 14-17). However, perhaps the most important finding in recent empirical papers is that of non-normal distributions of financial ratios (Lev and Sunder 1979), a discovery important to both practitioners and researchers. The normal distribution is very practical because the mean and standard deviation are sufficient to characterise the whole distribution. In addition, many statistical tools presuppose normally distributed variables.

1.2 Previous Research

The last decade has seen a growing interest in analysing the distributional properties of financial ratios. In the seminal work on financial ratio analysis Horrigan (1965) found that some financial ratios tend to be normally distributed, but that there was also some evidence of positive skewness across many others. Pinches, Eubank, Mingo and Caruthers (1975) found considerable skewness in financial ratio distributions, and a logarithmic transformation improved normality, reduced outliers and improved homoscedasticity of the distributions. Deakin (1976) analysed the cross-sectional distributions of eleven ratios over the period 1955 to 1973 for COMPUSTAT 1800 Company File. The analysis showed that ten of the eleven ratios were distributed in a manner that was significantly different from a normal distribution. However, it appeared that normality could sometimes be achieved by transforming the data with square-root and logarithmic transformations.

Foster (1978, p. 70) was first to suggest that the treatment of outliers is an important problem in ratio analysis. Lev and Sunder (1979) analysed the problem of outliers very carefully, confirming that in financial ratio analysis unusually large values often occur because the denominator of a ratio is close to zero. They also suggested two techniques to handle outliers in financial ratio analysis: "trimming", i.e. the removal of an equal number of the smallest and largest observations from the sample, and "winsorizing", i.e. changing the value of an outlier to that of the closest non-outlier (see Lev and Sunder 1979, p. 207). They also suggested that equally-weighted averages as estimates of industry standards would be more sensitive to outliers than value-weighted averages. The findings of Yli-Olli and Virtanen (1985) strongly confirmed these hypotheses.

Frecka and Hopwood (1983) examined the same ratios as Deakin (1976). They concluded that the skewness and non-normality of the ratios may be caused by outliers. Outliers were identified using both skewness and kurtosis tests. Using square-root transformations, deleting a few outliers, and using specific industry grouping they achieved dramatic changes in the shapes of distributions. Normality or approximate normality was usually achieved for all distributions except the Cash Flow/ Total Debt (CF/TD) ratio.

The paper of Buijink and Jegers (1986) confirmed the importance of industry homogeneity for the form of ratio distributions.

1.3 The Distribution Properties of Financial Ratios

A good deal of empirical research either examines whether the normal distribution can be used to describe financial ratios, or it attempts to transform the data into a form adequate for a normal distribution assumption. More attention may need to be paid in future to the theoretical features and empirical interpretations of financial ratios. This means theoretical analysis of the kind of distributions presumed to best describe different ratios. It then has to be decided if it is appropriate to transform the data to obtain normality, and what is the economic meaning of the transformed data in different transformations.

There are many theoretical reasons why distributions of the raw scores of financial ratios cannot be expected to be normal, or even symmetrical. Some financial ratios have technical limits which prevent their symmetry; e.g. the current ratio and quick ratio have a technical lower limit of zero (see Foster 1986, p. 102-104). Ratio distributions also tend to be (positively) skewed because a unit decrease in the denominator produces a larger absolute change in the ratio value than its equal increase (see e.g. Frecka and Hopwood 1983, p. 117). The third reason is that there will be outside pressure on firm management to keep at least some of the ratios within certain acceptable limits (Buijink and Jegers 1986, p. 338).

Theoretical analysis can lead to better hypotheses on the suitability of different transformations to obtain data such that normal distribution assumption is descriptive. Theoretical analysis shows what kind of transformations can be presumed to give the best results. In addition, it gives us advice for empirical interpretations. This is important especially when we are deleting some observations from the sample as outliers. Theoretical analysis can confirm our interpretations that some observations are true outliers when we have theoretical arguments to expect normal distributions. In the opposite case, when we have theoretical arguments to expect non-normality, such interpretations would be much more difficult.

1.4 The Purpose of the Study

The purposes of this paper are:

1. To analyse the cross-sectional properties of selected financial ratios for normality: first, without deleting any extreme values or making any transformations; second, by using an appropriate transformation; and third, by using the transformation and by deleting extreme values. In addition, we attempt to analyse whether the observed extreme values are true outliers.

2. To analyse time-series behaviour of the ratios' cross-sections, in particular, how the cross-sections of the selected ratios behave during different business cycles. This is done by regressing each of the first four moments on an index describing the business cycles in the Finnish economy.

2 The Selection of the Ratios and Empirical Variables

2.1 The Selection of the Ratios

For this study we selected 12 different financial ratios which according to the textbooks (see e.g. Lev 1974, p. 28, Foster 1978, p. 28 and Tamari 1978, p. 24-44), measure short-term solvency (liquidity ratios), long-term solvency (leverage/ capital structure ratios), profitability (profitability ratios), and efficiency (turnover ratios) of the firm. The liquidity ratios examined are the current ratio (CR), the quick ratio (QR) and the defensive interval measure (DI). The selected long-term solvency ratios are debt-to-equity (DE), long-term debt to equity (LTDE) and times interest earned (TIE). Profitability ratios are earnings to sales (ES), return on assets (ROA) and return on equity (ROE). Finally, the selected efficiency ratios are total assets turnover (TAT), inventory turnover (IT) and accounts receivable turnover (ART).

The selected categories of the ratios and the ratios themselves are illustrative rather than exhaustive. For example, many popular market based ratios such as earnings per share (EPS) and price per earnings (P/E) are excluded. There are two preliminary reasons for our selection. First, we compare the results of this study to those of Yli-Olli and Virtanen (1985), who used the same ratios. Their research generated interesting hypotheses concerning the importance of extreme values to some of the selected ratios. This is a very important consideration, although the results also showed that the empirical classification of the selected ratios was not identical to an a priori classification, i.e. that presented in textbooks. Second, we will reserve the possibility to compare our results to those of Buijink and Jegers (1986) from Belgium. Included in their research were eleven of the twelve ratios presented e.g. by Foster (1978), used by Yli-Olli and Virtanen (1985), and also adopted in this study.

Before moving to the empirical work we first try to analyse theoretically whether a normal distribution could, a priori, be valid for describing the selected financial ratios before deleting extreme values or transforming the data.

The first category consists of the liquidity ratios: current ratio (CR), quick ratio (QR) and defensive interval measure (DI). All the liquidity measures have, in practice, a technical lower limit of zero, in which positive skewness of the original variables seems to be obvious.

The second category contains the long-term solvency ratios: debt to equity (DE), long-term debt to equity (LTDE) and times interest earned (TIE). Debt to equity and long-term debt to equity also have their technical lower limit of zero. The original values of those variables are also expected, a priori, to have positively skewed distributions. According to the textbooks, the third long-term solvency ratio, the times interest earned ratio, incorporates a dynamic element in long-term solvency evaluation. However, we can also interpret this as a measure of profitability which has been deflated by the interest rate. Our earlier empirical results confirm this interpretation (Yli-Olli and Virtanen 1985, p. 40, 44 and 47). When the numerator of this ratio is negative we have no economic interpretation for the ratio, so in practice the numerical values of this ratio are also expected to have a positively skewed distribution.

In the third category we have the profitability ratios: earnings to sales (ES), return on assets (ROA) and return on equity (ROE). All the profitability measures usually have large (and positive) denominators compared to their numerators. In addition, the numerators can vary freely from negative to positive values. All these variables are technically good in the respect that they are, a priori, quite stable, and there is no range in the distribution for which economic interpretation is impossible. We thus assume that the normal distribution assumption is descriptive for profitability ratios.

Finally, in the fourth category we have the efficiency ratios: total assets turnover (TAT), inventory turnover (IT) and accounts receivable turnover (ART). The sample used for this study includes in principle all firms quoted on the Helsinki Stock Exchange except banks and insurance companies, so the distributions of efficiency ratios are expected to be non-normal because the relation between sales and equity, the inventory policy, and the efficiency of the credit department may differ very much in different industries.

2.2 Empirical Variables

The firms used in this study cover all the firms quoted on the Helsinki Stock Exchange excluding banks and insurance companies. The number of firms is 42 and the period examined is 1974-1984. The ratios have been calculated using the definitions presented by Foster (1978, p. 43-44) and the basic financial items according to the recommendations of the Finnish Credit Analysis Commission (see Yritystutkimus-neuvottelukunta 1983).

In order to determine the stability of the observed distributions the analysis runs for eleven different cross-sections using the same firms each year, with special emphasis on detecting differences in distributions during different business cycles.

3 Methodology

Methodological interests in the study are focused on two main topics. First, the question of normality is dealt with – in the raw data, in the transformed data, and in data excluding outliers. Second, the behaviour of the distributions of the selected ratios during different business cycles is modeled and analysed.

3.1 Testing the Normality of the Distributions

The question of normality concentrates on four issues: (i) assumptions or hypotheses concerning the raw data, (ii) use of transformations to achieve the desired result – normality – for non-normal raw data distributions, (iii) choice of an appropriate and powerful statistical normality test, and (iv) detection and removal of outliers from the main body of the distribution. Each of these issues is briefly discussed and the choices made are introduced in this section.

3.1.1 Raw Data Distributions

In the earliest studies on ratio distributions, normal distribution was the only hypothetised statistical model for raw data (e.g. Horrigan 1965, O'Connor 1973, Deakin 1976, and Bird and McHugh 1977). As the number of studies increased, the general conclusion developed that the majority of ratio distributions tend to be positively skewed and thus non-normal. Many other statistical models have thus been introduced to describe the cross-sectional behaviour of financial ratios. The log-normal distribution (Fieldsend, Longford and McLeay 1987) and the family of stable Paretian distributions (So 1987) have been used, among others, as models for raw ratio distributions.

The most promising approach to choose a model for financial ratios seems to be the gamma distribution family approach. The gamma distribution is particularly appropriate for both skewed and symmetric data, and is also suitable when dealing with outliers (Barnett and Lewis 1978, p. 76, Frecka and Hopwood 1983, p. 117, and Ezzamel, Mar-Molinero and Beecher 1987, p. 469). This distribution contains as its special cases the exponential, chi-square, and normal distributions.

The probability density of the gamma distribution is fixed by two parameters: a shape parameter α and a scale parameter β. The density function is of the following form:

$$f(y) = \begin{cases} \dfrac{y^{\alpha-1} e^{-y/\beta}}{\beta^{\alpha}\,\Gamma(\alpha)}, & y > 0 \\ 0, & y \leq 0 \end{cases} \qquad (1)$$

where $\Gamma(\alpha)$ is the usual gamma function

$$\Gamma(\alpha) = \int_0^{\infty} x^{\alpha-1} e^{-x}\, dx . \qquad (2)$$

One can easily see that the combination $\alpha = 1$, $\beta = 1$ generates the exponential distribution, and the combination $\alpha = 2$, $\beta = 1$ produces a chi-square distribution, while an approximately normal distribution can be achieved by choosing e.g. $\alpha = 4$, $\beta = 1$.

Much empirical evidence exists that the main body of a ratio distribution follows either the normal or a positively skewed distribution (for a summary, see Ezzamel, Mar-Molinero and Beecher 1978, p. 464-466). This type of ratio behaviour can also be argued for theoretically (Frecka and Hopwood 1983, p. 117, Buijink and Jegers 1986, p. 338). The gamma distribution is thus in good accordance with both empirical and theoretical reasoning on raw data behaviour.

3.1.2 Square-root Transformation

A variety of transformation techniques to achieve normality for ratio distributions has been suggested in the literature. These include natural logarithms, square- and cube-roots, and other power transformations. All work in the same direction: they reduce the positive skewness inherent in a distribution. But they also possess differences in their behaviour.

Both natural logs and square roots suffer from the defect that they cannot be applied if ratios are negative. This difficulty can be avoided, however, by adding a small constant to the ratio. For ratios which exceed one all the above transformations work similarly, having a smooth proportionate effect which reduces the relative weight given to large observations. But for ratios between zero and one the effect of the log transformation is disproportionate - the smaller the observation the more drastic the effect of the log transformation. In these cases the log transformation can, in fact, easily "over-transform" the data: from positive skewness in the raw data one obtains negative skewness in the transformed data.

There is no unanimous empirical evidence in support of a single transformation technique, although results supporting the use of square-root transformation seem to be in a majority (see e.g. Deakin 1976, p. 93-95, and Ezzamel, Mar-Molinero and Beecher 1987, p. 474-479). The most important support for the square-root transformation comes from its consistency with the underlying gamma distribution hypothesis. For, if the raw data follow a gamma distribution with parameters α and β (cf. equation (1) above), then the square-root transformed data are approximately normally distributed with mean $(\beta(\alpha\text{-}1/4))^{1/2}$ and variance $\beta/4$ (Barnett and Lewis 1978, p. 88, Frecka and Hopwood 1983, p. 118-119). For these reasons the square-root transformation technique is preferred in this study.

3.1.3 The Shapiro - Wilk Normality Test

The most common normality tests are the chi-square (χ^2) test, the Kolmogorov - Smirnov test (and its derivative, the Lilliefors test), and the Shapiro - Wilk W-test. Frecka and Hopwood (1983) and So (1987) have applied normal-based sample skewness and kurtosis tests introduced by Barnett and Lewis (1978, p. 102).

The χ^2 test is based on asymptotic theory and is, therefore not appropriate in our small sample study. The test also has the disadvantage of using aggregation of data, the number and character of class intervals being arbitrary. The Kolmogorov - Smirnov test and the Lilliefors test treat observations separately, thus avoiding information loss resulting from aggregation of categories. Moreover, the tests are distribution-free and suitable for small samples (Siegal 1956, Lilliefors 1967). The power and sensitivity to non-normality of these Kolmogorov - Smirnov type distance tests are, however, not especially high. They are typically outperformed by the Shapiro - Wilk test (Shapiro and Wilk 1968).

The Shapiro - Wilk test is effective for normality even with very small ($n \leq 20$) samples. It is also especially sensitive to asymmetry, long-tailedness and outliers, i.e. to characteristics expected to be possessed by the ratio distributions in the raw form. The normality tests in this study are carried out with the Shapiro - Wilk test.

3.1.4 Outliers

Besides skewness, the presence of extreme outliers can also cause a considerable departure from normality. Several truncation techniques, e.g. trimming and winsorizing, have been suggested for handling the outliers.

It is, however, quite common for the truncation methods applied to be rather mechanical in nature: Bougen and Drury (1980) remove observations greater than three standard deviations from the mean, Donnithorne (1981) quite arbitrarily sets minimum and maximum values for each ratio beyond which observations are removed, while Frecka and Hopwood (1983) remove observations from the transformed distribution until its skewness and kurtosis fit with those of the normal distribution, etc. Care should be taken, however, that only obvious outliers are removed (Ezzamel, Mar-Molinero and Beecher 1987). Our objective is to use, besides statistical tests, also exogeneous information (information on business cycles, firm-specific knowledge, etc.) for detecting and removing the obvious or "true" outliers.

3.2 Ratios and Business Cycles

In order to analyse how the cross-sectional ratio distributions behave during different business cycles, a regression approach is utilised. Time series of the most central ratio statistics, i.e. mean, variance, skewness, and kurtosis, are regressed on an index series which describes Finnish firms' competitiveness during the period examined. This competitiveness index is used as an indicator of business cycles for Finnish industry. The univariate regression models - different ratio statistics as dependent variables and the competitiveness index as an explanator - are experimented with using different lags to gain insight into the temporal interdependence between business cycles and general performance of the firms.

4 Empirical Results

In this section we analyse the cross-sectional distributions of the selected ratios. First, we present the four moments - mean, variance, skewness and kurtosis - of the ratios for the years 1974-1984. Thereafter we present the Shapiro-Wilk test statistics for the raw data. Finally, we apply the Shapiro-Wilk test to the transformed data (the square-root transformation). Where the transformed data is not normal we remove observations one by one to make it normal. Moreover, we try to identify and remove only such observations as are true outliers. Such identification is possible because our population is very small.

In addition, we will use regression analysis to determine, how the cross-sectional distributions of the selected ratios behave during different business cycles. The Finnish economy is very open. During the period examined Finnish foreign trade accounted for about 30 percent of the gross domestic product (on average). At the beginning of the period inflation in Finland was over 10 percent, and Finnish firms very rapidly lost their competitiveness both at home and abroad. The Finnish mark was devalued in 1977. Appendix 1 presents the index describing the Finnish firms' competitiveness during the period examined.

4.1 Cross-sectional Distributions of the Selected Ratios

Tables 2.1 - 2.3 in Appendix 2 show the cross-sectional distributions of the short-term solvency or liquidity ratios. According to our a priori hypotheses, all the liquidity ratios are, as a rule, positively skewed before transformation. However, even the raw data for quick ratio is normally distributed during the years 1977-1979. The square-root transformed data make a better fit with the normal distribution for the liquidity ratios. In the case of the quick ratio, transformation of the data makes distributions normal in all the years examined. After removing no more than two observations from the sample the square-root transformation also normalises the distributions of the current ratio and defensive interval measure. However, although we know that the removed firms are very profitable we cannot absolutely identify them as true outliers.

The removed firms are not identical in terms of current ratio and defensive interval measure. This supports the results of Yli-Olli and Virtanen (1985). The defensive interval measure does not measure the same characteristic of the firm's liquidity as the current and quick ratios (current and quick ratios are static measures and defensive interval measure is a dynamic one).

Tables 2.4 - 2.6 in Appendix 2 show the cross-sectional distributions of the long-term solvency ratios. According to our hypotheses, all the long-term solvency ratios are also supposed to have positively skewed distributions, mainly for technical reasons. The ratios have their lower limit at zero. In the case of the defensive interval measure we have a similar situation. We have no economic interpretation for the negative ratio values. In addition, the ratios where the numerator is large compared with the denominator tend to produce positively skewed distributions.

The results obtained confirm our hypotheses. The raw data distributions are, with one exception (times interest earned in 1977), positively skewed. The square-root transformation, without removing any observations, made data normally distributed for all long-term solvency ratios.

Tables 2.7 - 2.9 in Appendix 2 show the cross-sectional distributions of the profitability ratios. We presumed that profitability ratios would be normally distributed, because they are technically "ideal" financial ratios. However, one of the commonly used profitability ratios, earnings to sales, is theoretically not a good profitability measure. Its numerator is earnings after extra items, which "belongs" to equity. Denominator sales "belongs" to both liabilities and equity. A better numerator for this ratio would be e.g. earnings before interest and taxes. This is particularly applicable in Finland, where liabilities of nearly all firms exceed equity.

We found that the distribution of the raw data for earnings to sales is normally or almost normally distributed. There were some outliers during the recession, when the competitiveness of Finnish firms was very weak. In such cases outliers are as a rule negative (distribution is skewed to the left) and thus represent very unprofitable firms. The square-root transformation does not change the results essentially. Some years the transformed data were a bit closer to normal and some years the raw data were more normally distributed. Therefore we do not present transformed data for profitability ratios. After removing no more than two outliers the distribution becomes normal for every year. However, the removed firms are not the same every time.

The distribution for the ratio return on assets is, as a rule, normal. There are three exceptions when the distribution was mildly positively skewed according to the

Shapiro-Wilk test (years 1975, 1976 and 1979). In addition, the distribution seems to be skewed slightly to the left during 1977 and 1978. Some firms took more time to improve their results after the devaluation of the Finnish mark in 1977.

The distributions for the return on equity are very similar to those for the return on assets, although the timing of the skewed distributions is a bit different. Before devaluation there are no positively skewed distributions. After devaluation the situation is the same for both ratios, and the distribution is slightly skewed to the left. It is very interesting to find that firm number 6 (Oy Wilh. Schauman Ab) is a negative outlier in 1977 and a positive outlier in 1980. The accounting beta must be very large for that firm. After removing at most one or two outliers the distribution becomes normal for every year. According to our hypotheses the distributions of the profitability ratios should be normal even without transformation.

Tables 2.10 - 2.12 in Appendix 2 show the cross-sectional distributions for the efficiency ratios. Efficiency ratios are the most heterogeneous group of the selected ratios in this study. In addition, their numerical values are so high that we can assume positively skewed distributions (see Frecka and Hopwood 1983, p. 117). The raw data for all efficiency ratios – total assets turnover, inventory turnover and accounts receivable turnover – are positively skewed. After square-root transformation total assets turnover and inventory turnover remain positively skewed, but accounts receivable turnover becomes normal. There are no outliers. This means that terms of payment as well as payment policies are very similar for all Finnish firms.

When we analysed the outliers of the transformed data for total assets turnover and inventory turnover we found that all the outliers were trade and transport companies (the sample includes industrial companies as well as trade and transport companies). Tables 2.13 and 2.15 (Appendix 2) show the cross-sectional distributions of the ratios total assets turnover and inventory turnover for industrial companies. The corresponding distributions for trade and transport companies are given in Tables 2.14 and 2.16 (Appendix 2), respectively. For industrial companies, the distributions of raw data remain positively skewed, although the square-root transformation renders them normal. There are two exceptional years for inventory turnover where we have slight positively skewed distributions which became normal after removing one or two outliers. The situation is almost similar for trade and transport companies. Even raw data without transformation for total assets turnover are normally distributed. After removing two outliers the transformed data of inventory turnover also become normal.

The results show that it was necessary to divide firms into different industries only when we analysed efficiency ratios. All the other ratios were normally distributed (either in raw or transformed data form and after removing, when necessary, some outliers).

4.2 *Cross-sectional Distributions of the Financial Ratios During Different Business Cycles*

Next we analyse by regression analysis how the cross-sectional distributions of the selected ratios behave during different business cycles. Tables 1-3 show the results of regression analysis when the dependent variables are the mean, standard deviation, skewness, and kurtosis, respectively, of the cross-sectional distributions of the short-term solvency or liquidity ratios. The independent variable is the Finnish firms' competitiveness index lagged from 0 to 3. The tables present only the t- and p-values for the coefficients of the independent variable.

Tables 1-3 show that the coefficients of the mean and standard deviation do not differ from zero at the 5 % level of significance. The result thus confirms the well-known assumption that firms must always be liquid and, because maintaining liquidity causes expenditures for firms, the mean and standard deviation cannot change very much during different business cycles. However, it is interesting to see that the lagged model – when skewness and kurtosis are dependent variables – produces statistically significant coefficients. The skewness and kurtosis of the quick ratio seem in particular to follow in lag fashion (one, two and three years) the competitiveness index of Finnish

Table 1 *Regression analysis results (t- and p-values) for current ratio with different lags in the explanator*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	-0.549	0.591	-0.312	0.759	1.476	0.162	1.031	0.320
-1	0.295	0.772	0.270	0.791	1.904	0.078	1.144	0.272
-2	-0.079	0.938	-0.307	0.764	1.685	0.114	1.347	0.199
-3	-0.970	0.348	-1.188	0.254	0.934	0.366	1.154	0.268

Table 2 *Regression analysis results (t- and p-values) for quick ratio with different lags in the explanator*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	-0.648	0.528	-0.846	0.412	-0.095	0.926	-0.109	0.914
-1	-0.143	0.888	0.005	0.996	4.135	0.001	2.433	0.029
-2	-0.565	0.581	-0.182	0.859	6.794	0.000	4.646	0.000
-3	-1.297	0.216	-0.838	0.416	2.310	0.037	3.174	0.007

Table 3 *Regression analysis results (t- and p-values) for defensive interval measure with different lags in the explanator*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	-0.728	0.479	-0.353	0.729	0.446	0.662	0.412	0.687
-1	-0.525	0.608	-0.149	0.884	0.237	0.816	-0.061	0.952
-2	-0.961	0.353	-0.846	0.411	-0.675	0.511	-0.905	0.381
-3	-1.498	0.156	-1.542	0.145	-1.205	0.248	-1.084	0.297

firms. This finding indicates that the liquidity of a few firms differs from the average in this sample during the boom period (lagged) and returns to "normal" during recession (lagged).

Tables 4-6 show the results of regression analysis for the long-term solvency ratios. The independent variable is again the Finnish firms' competitiveness index lagged from 0 to 3, respectively.

According to our earlier results all the long-term solvency ratios have positively skewed distributions. In addition, we can assume that during the boom period the indebtedness of firms will fall and in the recession it will correspondingly rise. The results in Tables 4 and 5 only partly confirm this assumption however. The dependence of the mean of the different solvency ratios on the competitiveness index is not significant. But the standard deviation of both the debt to equity and the long-term debt to equity follows inversely and with two or three years lag in relation to this index. The results indicate that some firms react – as far as indebtedness is concerned – more sensitively to business cycles than the sample average. The results on skewness and kurtosis also show that there are firms in the sample which behave differently, especially during the recession period. The results in Table 6 confirm our earlier conclusion that the ratio times interest earned does not measure the long-term solvency (see Yli-Olli and Virtanen 1985, p. 51) as much as profitability of the firm.

Table 4 *Regression analysis results (t- and p-values) for debt to equity with different lags in the explanator*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	1.664	0.118	3.422	0.004	4.082	0.001	4.078	0.001
-1	-0.723	0.482	-0.055	0.957	0.664	0.518	0.846	0.412
-2	-1.369	0.193	-2.754	0.015	-1.668	0.117	-1.616	0.128
-3	-0.359	0.725	-2.169	0.048	-2.274	0.039	-2.267	0.040

Table 5 *Regression analysis results (t- and p-values) for long-term debt to equity with different lags in the explanator*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	2.204	0.045	3.866	0.002	4.713	0.000	4.009	0.001
-1	-0.673	0.512	0.251	0.805	1.401	0.183	1.174	0.260
-2	-1.864	0.083	-2.362	0.033	-0.922	0.372	-1.146	0.271
-3	-0.864	0.402	-2.177	0.047	-1.807	0.092	-1.845	0.086

Table 6 *Regression analysis results (t- and p-values) for times interest earned with different lags in the explanator*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	0.438	0.668	-0.213	0.835	0.662	0.518	0.080	0.937
-1	1.213	0.245	0.603	0.556	1.844	0.087	1.227	0.240
-2	0.177	0.862	0.113	0.911	1.362	0.195	1.434	0.174
-3	-1.075	0.300	-0.575	0.575	1.274	0.223	1.423	0.177

Tables 7-9 show the regression results for the profitability ratios. The numerical values of the profitability ratios presumably follow the business cycles. However, it is difficult to make any a priori conclusions about the lag structures of the variables.

The mean values of the profitability ratios seem to follow the competitiveness index, with a lag of one year. However, the coefficient of the variable earnings to sales does not differ significantly from zero. In addition, the firms seem to react differently in business cycles. During the boom period, some firms can increase their profitability

Table 7 *Regression analysis results (t- and p-values) for earnings to sales with different lags in the explanator*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	0.485	0.635	-0.716	0.486	0.200	0.844	-0.001	0.999
-1	0.985	0.341	-0.532	0.603	2.389	0.032	-1.417	0.179
-2	-0.207	0.839	-0.635	0.536	1.502	0.155	-1.439	0.172
-3	-1.660	0.119	-1.049	0.312	0.578	0.599	-0.529	0.605

Table 8 *Regression analysis results (t- and p-values) for return on assets with different lags in the explanator*

Lag	Mean		Standard deviation		Skewness		Kurtosis	
	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	1.252	0.231	-0.408	0.689	0.633	0.537	0.626	0.542
-1	2.079	0.056	0.072	0.943	1.904	0.078	0.014	0.989
-2	0.262	0.797	-0.271	0.791	0.678	0.509	-1.612	0.129
-3	-1.674	0.116	-1.011	0.329	0.218	0.831	-2.627	0.020

Table 9 *Regression analysis results (t- and p-values) for return on equity with different lags in the explanator*

Lag	Mean		Standard deviation		Skewness		Kurtosis	
	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	1.841	0.087	1.243	0.234	0.230	0.822	2.344	0.034
-1	3.871	0.002	-1.584	0.136	3.289	0.005	-0.834	0.418
-2	0.739	0.472	-2.575	0.022	1.868	0.083	-2.402	0.031
-3	-1.861	0.084	-1.714	0.109	-0.115	0.909	-1.834	0.088

more than others, and in recession, some lose more profitability than the average. This can be seen from the behavior of the skewness index which quite closely follows (one year lagged) the competitiveness index. Business cycles thus have effects on profitability, both on average and in different ways from firm to firm.

Finally, Tables 10-12 present the results for the efficiency ratios. These seem to be the most heterogeneous group of the ratios selected for this study.

Table 10 *Regression analysis results (t- and p-values) for total assets turnover with different lags in the explanator*

Lag	Mean		Standard deviation		Skewness		Kurtosis	
	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	1.194	0.252	0.239	0.814	-0.527	0.606	-0.685	0.505
-1	1.442	0.171	0.970	0.349	0.239	0.815	0.225	0.825
-2	1.520	0.151	1.753	0.102	0.420	0.681	0.447	0.662
-3	1.264	0.227	2.295	0.038	0.432	0.673	0.245	0.810

Table 11 *Regression analysis results (t- and p-values) for inventory turnover with different lags in the explanator*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	-0.237	0.816	-0.496	0.628	-1.277	0.223	-1.275	0.223
-1	0.126	0.901	0.226	0.825	0.300	0.769	0.300	0.768
-2	0.050	0.961	0.644	0.530	1.558	0.142	1.630	0.125
-3	-0.124	0.903	0.704	0.493	1.331	0.205	1.441	0.172

Table 12 *Regression analysis results (t- and p-values) for accounts receivable turnover with different lags in the explanator*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	1.229	0.239	1.703	0.111	1.462	0.166	1.794	0.095
-1	-0.360	0.724	-0.921	0.372	-0.938	0.364	-0.925	0.370
-2	-0.936	0.365	-2.348	0.034	-2.742	0.016	-2.864	0.013
-3	-0.557	0.586	-1.565	0.140	-2.665	0.019	-2.337	0.035

The presented cross-sectional distributions showed (Tables 2.10 - 2.18 in Appendix 2) that the results of these ratios were very different between the industrial companies and the trade and transport companies. It is interesting to note in this context that, as a rule, only the efficiency ratios required us to divide the firms into different industries to get more reliable results. Many of the Finnish firms quoted on the Helsinki Stock Exchange are multibranch firms, or at least not working purely in one line of business, and so the classification of firms into different business lines does not usually generate more reliable results.

Tables 13 and 14 show that in both the industrial companies and the trade and transport companies the standard deviation of the variable total asset turnover follows in lagged fashion the competitiveness index of the Finnish firms. The lag structure is one or two years long. In addition, the skewness and kurtosis have the same kind of lag structures in industrial firms, which means that among the industrial firms there are some whose total asset turnover rises very high during the boom period (lagged).

Table 13 *Regression analysis results (t- and p-values) for total assets turnover with different lags in the explanator (industrial companies)*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	1.741	0.105	3.243	0.006	1.613	0.131		
-1	1.052	0.311	3.755	0.002	2.686	0.018	3.157	0.007
-2	0.910	0.378	4.009	0.001	3.316	0.005	3.629	0.003
-3	1.906	0.077	3.001	0.010	2.710	0.017	2.145	0.050

Table 14 *Regression analysis results (t- and p-values) for total assets turnover with different lags in the explanator (trade and transport companies)*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	2.062	0.060	4.716	0.000	1,063	0.307	0.873	0.398
-1	1.844	0.087	4.046	0.001	-0.484	0.636	0.674	0.511
-2	1.525	0.150	3.645	0.003	-0.763	0.458	0.259	0.799
-3	2.151	0.049	3.543	0.003	-0.641	0.532	-0.131	0.898

Tables 15 and 16 show the results for the inventory turnover. It is very important to note that in industrial firms the mean value falls and standard deviation rises during the boom period, and in recession vice versa. This means that average inventory compared to sales is bigger in the boom period than in the recession. It also means that the variance of the average inventory follows more closely the business cycles than that of the sales. The lag structure is about the same as the profitability ratios have. This phenomenon is at least partly caused by the Finnish tax regulations, which permit undervaluation of the inventory in the balance sheet. Therefore, when the profitability

Table 15 *Regression analysis results (t- and p-values) for inventory turnover with different lags in the explanator (industrial companies)*

	Mean		Standard deviation		Skewness		Kurtosis	
Lag	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
0	-2.319	0.037	1.393	0.187	1.632	0.127	1.684	0.116
-1	-2.823	0.014	1.539	0.146	2.188	0.046	2.277	0.039
-2	-2.148	0.050	1.578	0.137	1.072	0.302	1.130	0.277
-3	-2.417	0.030	1.152	0.268	1.001	0.334	0.747	0.467

Table 16 *Regression analysis results (t- and p-values) for inventory turnover with different lags in the explanator (trade and transport companies)*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	1.936	0.075	2.713	0.018	3.145	0.008	3.137	0.008
-1	0.654	0.524	1.366	0.194	2.850	0.013	2.749	0.016
-2	0.093	0.927	0.567	0.579	2.141	0.050	2.123	0.052
-3	0.046	0.964	0.450	0.659	1.596	0.133	1.517	0.152

of industrial firms has been very good during the boom period, they have strongly increased their average inventory. In this way they have been able to diminish their taxation in the short term. Correspondingly, the firms have presented better results for taxation during recession (by diminishing the inventory reserves). Skewness and kurtosis follow the competitiveness index of Finnish firms among both industrial companies and trade and transport companies.

Tables 17 and 18 show the results for the variable accounts receivable turnover. The variable has been said to indicate the efficiency of the credit department. Even when we

Table 17 *Regression analysis results (t- and p-values) for accounts receivable turnover with different lags in the explanator (industrial companies)*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	0.527	0.607	-0.823	0.425	-1.577	0.139	-1.646	0.124
-1	1.364	0.194	0.247	0.808	-0.814	0.429	-0.721	0.483
-2	2.081	0.056	1.352	0.198	0.571	0.577	0.647	0.528
-3	3.762	0.002	2.703	0.017	2.703	0.017	1.377	0.190

Table 18 *Regression analysis results (t- and p-values) for accounts receivable turnover with different lags in the explanator (trade and transport companies)*

Lag	Mean t-value	Mean p-value	Standard deviation t-value	Standard deviation p-value	Skewness t-value	Skewness p-value	Kurtosis t-value	Kurtosis p-value
0	-0.709	0.491	-1.441	0.173	0.072	0.944	-0.662	0.519
-1	-0.951	0.358	-1.401	0.174	-0.183	0.858	-0.543	0.596
-2	-0.830	0.421	-1.285	0.219	-0.472	0.644	-1.212	0.246
-3	-1.190	0.254	-1.580	0.136	-0.081	0.937	-0.964	0.352

divide the firms into different industries no clear dependence between the moments of the ratio and the competitiveness index seem to exist. The significant coefficients for three years lag (industrial companies) are the only noticeable signals. Due to the long lag these are difficult to interprete also.

5 Conclusions

The purpose of this study was to analyse the cross-sectional distributions of selected financial ratios and to analyse the time-series behaviour of these ratios during different business cycles. The twelve selected ratios were according to a priori classification the measures of short-term solvency (liquidity), long-term solvency, profitability, and efficiency of the firms. Lev (1974) and Foster (1978) presented those ratios in their textbooks and Yli-Olli and Virtanen (1985) and Buijink and Jegers (1986) have used the same ratios in their earlier researches.

We found, in accordance with our hypothesis, that the distributions of all the liquidity ratios were positively skewed, and that the square-root transformation made them normal. The quick ratio was normal with no outliers. After removing some outliers from the transformed data the current ratio and the defensive interval also became normal. We also found that changes in the competitiveness of Finnish firms affect the distributions of the ratios. During the boom some outliers appeared, while during the recession they disappeared. It was also possible to model this behaviour: the skewness and kurtosis of liquidity ratios fitted a significant regression model with the competitiveness index of Finnish firms as the explanator.

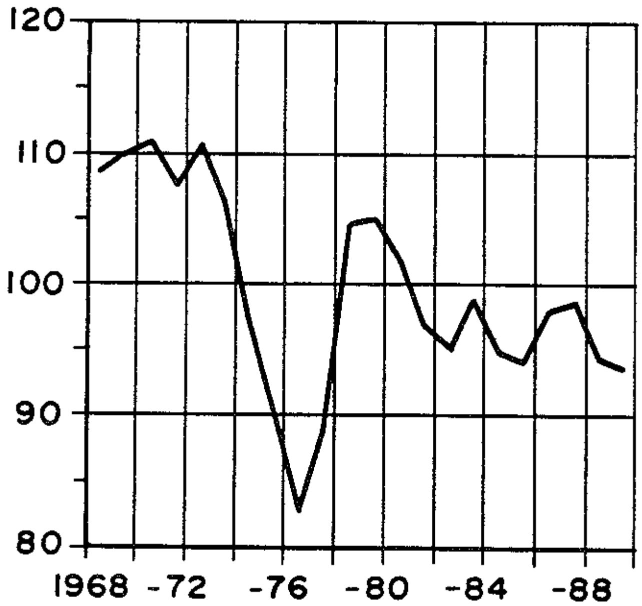
The distributions of the long-term solvency ratios were also, before transformation, positively skewed. The square-root transformation and deleting some outliers made the ratios normally distributed. We also found that the existence of outliers for the ratios debt to equity and long-term debt to equity strongly depend on the competitiveness of the Finnish firms. In the regression approach, the standard deviation, skewness and kurtosis could be regressed on the competitiveness index (debt to equity and long-term debt to equity ratios). The lag structure was about two or three years.

The distributions of the third long-term solvency ratio, times interest earned, behaved like those of the profitability ratios. In Finnish data (very levered firms), this variable is in fact a measure of profitability. Earnings before interest and taxes are deflated by interest payments. The result confirms the earlier result by Yli-Olli and Virtanen (1990).

The profitability ratios are ideal among the selected ratios in that we can assume their distributions to be normal without any transformation. The empirical results confirmed this hypothesis. As also hypothesised, the profitability ratios followed the business cycles very closely, both on average (the mean of the distribution) and firm-specific (outliers, the skewness of the distribution).

Finally, we analysed the efficiency ratios. We pre-supposed the efficiency ratios to be the most heterogeneous group among the selected ratios. The distributions of the raw data were positively skewed, but after the square-root transformation the accounts receivable turnover became normally distributed. The transformed distributions for total assets turnover and inventory turnover remained positively skewed. When we divided our data into different industries the distributions became normal. This partition was not necessary for other financial ratios. Of the efficiency ratios, inventory turnover had the closest connections to the business cycles (among industrial firms). One explanation for this dependence lies in Finnish tax laws: firms are able to reduce their taxes by utilising inventory reserves.

Appendix 1 *The Finnish firms' competitiveness (relative unit labour costs of OECD/Finland)*



Appendix 2

Table 2.1 *Descriptive statistics and test for normality of the distributions of current ratio*

Current ratio (CR)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	1.74	0.392	1.92**	4.58**	0.823**	0.890**	0.930* (30)	0.945 (30,40)			
1975	1.63	0.330	1.57**	3.88**	0.889**	0.946					
1976	1.56	0.325	1.49**	3.99**	0.909**	0.967					
1977	1.52	0.319	1.72**	5.10**	0.871**	0.942					
1978	1.55	0.360	1.51**	3.60**	0.888**	0.952					
1979	1.64	0.415	1.91**	4.71**	0.824**	0.905**	0.939* (30)	0.970 (30,16)			
1980	1.71	0.403	2.08**	5.29**	0.803**	0.881**	0.926* (30)	0.963 (30,16)			
1981	1.78	0.426	1.79**	4.16**	0.846**	0.908**	0.942 (30)				
1982	1.83	0.433	1.47**	2.65**	0.877**	0.933*	0.959 (16)				
1983	1.81	0.446	1.55**	3.24**	0.880**	0.939*	0.965 (16)				
1984	1.78	0.377	1.03**	1.14*	0.915**	0.948					

Table 2.2 *Descriptive statistics and test for normality of the distributions of quick ratio*

Quick ratio (QR)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	0.89	0.220	1.59**	3.58**	0.874**	0.955					
1975	0.83	0.184	1.63**	5.27**	0.879**	0.954					
1976	0.80	0.144	0.90**	1.88*	0.934*	0.965					
1977	0.79	0.119	0.42	0.62	0.975	0.975					
1978	0.86	0.151	0.41	0.01	0.969	0.977					
1979	0.93	0.171	0.87**	1.07*	0.944	0.980					
1980	0.95	0.160	1.40**	2.79**	0.906**	0.967					
1981	1.01	0.189	1.59**	3.44**	0.881**	0.948					
1982	1.09	0.188	1.25**	1.87*	0.905**	0.966					
1983	1.11	0.250	0.90**	0.68	0.934*	0.974					
1984	1.11	0.248	1.15**	2.01*	0.924*	0.975					

** significant at 1 % level
* significant at 5 % level
(30) firm n:o 30 (see Appendix 3) removed from the right tail of the distribution, etc.

Table 2.3 *Descriptive statistics and test for normality of the distributions of defensive interval measure*

Defensive interval (DI)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	89.	1945.	1.33**	1.35*	0.855**	0.924*	0.933* (23)	0.949 (23,25)			
1975	93.	1961.	1.21**	1.06*	0.889**	0.944					
1976	94.	2175.	1.48**	2.41**	0.872**	0.940*	0.956 (23)				
1977	94.	1822.	1.52**	3.12**	0.884**	0.952					
1978	104.	2411.	1.31**	1.88*	0.892**	0.951					
1979	109.	3375.	1.53**	2.52**	0.849**	0.924*	0.941 (23)				
1980	107.	3059.	1.75**	3.38**	0.834**	0.921*	0.947 (13)				
1981	106.	2557.	1.52**	2.42**	0.864**	0.935*	0.954 (23)				
1982	113.	2640.	1.35**	1.44*	0.859**	0.924*	0.938* (25)	0.968 (25,23)			
1983	120.	2482.	0.73*	0.04	0.943	0.975					
1984	121.	2769.	1.12**	0.97	0.905**	0.958					

Table 2.4 *Descriptive statistics and test for normality of the distributions of debt to equity*

Debt to equity (DE)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	2.53	1.92	1.32**	1.57*	0.881**	0.946					
1975	2.88	3.30	2.39**	7.62**	0.778**	0.895**	0.935* (42)	0.954 (42,32)			
1976	3.15	3.19	1.48**	1.72*	0.836**	0.908**	0.916* (42)	0.921* (42,32)	0.935* (42,32,21)	0.944 (42,32,21,6)	
1977	3.50	4.78	2.24**	6.45**	0.787**	0.896**	0.932* (6)	0.937* (6,21)	0.948 (6,21,42)		
1978	4.03	13.68	4.11**	21.11**	0.602**	0.821**	0.952 (6)				
1979	3.87	16.39	4.92**	28.12**	0.507**	0.767**	0.965 (6)				
1980	3.36	4.92	2.61**	9.55**	0.769**	0.909**	0.954 (6)				
1981	3.10	2.89	1.59**	3.41**	0.878**	0.963					
1982	3.10	4.02	2.22**	7.17**	0.821**	0.946					
1983	3.16	4.77	2.14**	5.49**	0.792**	0.925*	0.960 (6)				
1984	3.05	5.29	2.60**	9.37**	0.766**	0.910**	0.952 (32)				

** significant at 1 % level
* significant at 5 % level
(30) firm n:o 23 (see Appendix 3) removed from the right tail of the distribution, etc.

Table 2.5 *Descriptive statistics and test for normality of the distributions of long-term debt to equity*

Long-term debt to equity (LTDE)					Shapiro - Wilk's W-test statistics						
						Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	0	1	2	3	4	5
1974	1.21	1.04	2.57**	8.03**	0.741**	0.915**	0.954 (42)				
1975	1.31	1.56	3.27**	13.54**	0.672**	0.879**	0.949 (42)				
1976	1.41	1.13	1.59**	2.42**	0.837**	0.945					
1977	1.58	1.55	1.72**	3.52**	0.838**	0.950					
1978	1.93	4.26	3.42**	15.68**	0.670**	0.890**	0.941 (6)				
1979	1.93	6.18	4.38**	23.29**	0.555**	0.826**	0.935* (6)	0.937* (6,41)	0.940 (6,41,42)		
1980	1.63	2.37	2.64**	8.94**	0.727**	0.891**	0.927* (6)	0.935* (6,41)	0.938* (6,41,1)	0.949 (6,41,1,32)	
1981	1.51	1.51	2.00**	4.30**	0.786**	0.921*	0.937* (6)	0.948 (6,41)			
1982	1.59	2.00	2.06**	5.10**	0.782**	0.922*	0.933* (6)	0.943 (6,32)			
1983	1.65	2.34	1.88**	3.50**	0.777**	0.918**	0.939* (6)	0.948 (6,32)			
1984	1.58	2.26	2.32**	6.91**	0.775**	0.934*	0.960 (32)				

Table 2.6 *Descriptive statistics and test for normality of the distributions of times interest earned*

Times interest earned (TIE)					Shapiro - Wilk's W-test statistics						
						Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	0	1	2	3	4	5
1974	2.78	0.11	3.60**	17.20**	0.671**	0.886**	0.970 (30)				
1975	1.97	5.35	3.51**	14.62**	0.609**	0.864**	0.922* (36)	0.944 (36,28)			
1976	1.75	3.21	3.48**	16.46	0.692**	0.925*	0.983 (36)				
1977	1.61	2.00	0.90**	3.75**	0.945	0.900*	0.971 [40]				
1978	1.81	1.89	3.42**	15.68**	0.792**	0.916**	0.935* (30)	0.967 (30), [20]			
1979	2.44	3.66	1.76**	3.59**	0.822**	0.921*	Not possible to reach normality				
1980	2.18	1.57	2.49**	9.09**	0.797**	0.925*	0.976 (30)				
1981	2.30	3.43	3.42**	15.35**	0.678**	0.864**	0.957 (30)				
1982	2.35	2.66	1.31**	1.26*	0.860**	0.935*	0.946 (42)				
1983	1.84	1.44	1.79**	4.34**	0.861**	0.970					
1984	2.12	1.49	1.81**	3.23**	0.799**	0.886**	0.909** (28)	0.935* (28,30)	0.947 (28,30,35)		

** significant at 1 % level, * significant at 5 % level
(30) firm n:o 30 (see Appendix 3) removed from the right tail of the distribution, etc.
[40] firm n:o 40 (see Appendix 3) removed from the left tail of the distribution, etc.

Table 2.7 *Descriptive statistics and test for normality of the distributions of earnings to sales*

Earnings to sales (ES)					Shapiro - Wilk's W-test statistics					
						Number of removed outliers (no transformation)				
Year	Mean	Variance	Skewness	Kurtosis	Raw data	1	2	3	4	5
1974	0.039	0.0014	0.81*	1.31*	0.959					
1975	0.008	0.0013	0.08	0.86	0.936*	0.973* [16]	0.941 [16],(28)			
1976	0.002	0.0019	0.64*	1.82**	0.936*	0.958 (13)				
1977	0.003	0.0034	-1.60**	3.45**	0.868**	0.916** [20]	0.954 [20,40]			
1978	0.011	0.0020	-2.62**	13.00**	0.788**	0.968 [20]				
1979	0.038	0.0018	0.92**	1.11*	0.932*	0.949 (26)				
1980	0.032	0.0008	0.41	-0.53	0.953					
1981	0.029	0.0009	0.78*	1.47*	0.954					
1982	0.025	0.0013	0.13	-0.55	0.976					
1983	0.017	0.0009	-0.03	0.67	0.992					
1984	0.035	0.0010	0.99**	0.93	0.929*	0.977 (30)				

Table 2.8 *Descriptive statistics and test for normality of the distributions of return on assets*

Return on assets (ROA)					Shapiro - Wilk's W-test statistics					
						Number of removed outliers (no transformation)				
Year	Mean	Variance	Skewness	Kurtosis	Raw data	1	2	3	4	5
1974	0.123	0.0030	0.45	0.25	0.978					
1975	0.086	0.0045	1.83**	5.10**	0.861**	0.937* (36)	0.966 (36,28)			
1976	0.076	0.0036	1.16**	1.73*	0.920*	0.953 (36)				
1977	0.080	0.0046	-0.82*	2.02*	0.956					
1978	0.090	0.0016	-0.67*	2.10**	0.960					
1979	0.122	0.0059	1.61**	7.87**	0.859**	0.944 (26)				
1980	0.123	0.0021	0.46	1.99*	0.972					
1981	0.127	0.0029	0.64*	0.30	0.954					
1982	0.118	0.0030	0.67*	0.14	0.949					
1983	0.098	0.0020	0.32	0.82	0.982					
1984	0.120	0.0017	0.22	-0.22	0.980					

** significant at 1 % level, * significant at 5 % level
(16) firm n:o 16 (see Appendix 3) removed from the right tail of the distribution, etc.
[28] firm n:o 28 (see Appendix 3) removed from the left tail of the distribution, etc.

Table 2.9 *Descriptive statistics and test for normality of the distributions of return on equity*

Return on equity (ROE)					Shapiro - Wilk's W-test statistics					
					Raw data	Number of removed outliers (no transformation)				
Year	Mean	Variance	Skewness	Kurtosis		1	2	3	4	5
1974	0.148	0.0132	0.61*	0.75	0.958					
1975	0.049	0.0177	0.52	0.91	0.969					
1976	0.018	0.0292	0.00	0.83	0.983					
1977	0.014	0.0548	-1.43**	2.22**	0.872**	0.902** [20]	0.941 [20,6]			
1978	0.037	0.0566	-3.86**	20.17**	0.664**	0.984 [20]				
1979	0.174	0.0454	2.11**	8.81**	0.849**	0.983 (26)				
1980	0.173	0.0286	1.88**	4.67**	0.843**	0.907** (6)	0.966 (6,42)			
1981	0.138	0.0169	0.60*	0.49	0.965					
1982	0.108	0.0231	0.12	0.60	0.980					
1983	0.070	0.0123	-0.21	-0.14	0.987					
1984	0.127	0.0110	0.79*	0.76	0.944					

Table 2.10 *Descriptive statistics and test for normality of the distributions of total assets turnover*

Total assets turnover (TAT)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	1.40	0.610	2.10**	5.28**	0.790**	0.883**	0.919* (35)	0.929* (35,33)	0.938 (35,33,36)		
1975	1.29	0.646	2.08**	5.01**	0.787**	0.889**	0.920* (35)	0.931* (35,33)	0.939 (35,33,36)		
1976	1.30	0.638	1.74**	2.88**	0.801**	0.885**	0.902** (35)	0.905** (35,33)	0.913** (35,33,26)	0.926* (35,33,26, 38)	0.942 (35,33,26, 38,39)
1977	1.29	0.514	1.48**	1.84*	0.836**	0.907**	0.924* (33)	0.929* (33,35)	0.936* (33,35,38)	0.946 (33,35,38,39)	
1978	1.27	0.465	1.63**	2.26**	0.812**	0.884**	0.902** (33)	0.913** (33,35)	0.930* (33,35,38)	0.947 (33,35,38,39)	
1979	1.34	0.503	1.72**	2.77**	0.803**	0.871**	0.890** (35)	0.899** (35,33)	0.911* (35,33,38)	0.918* (35,33,38,39)	More than 5 outliers
1980	1.38	0.458	1.68**	2.59**	0.805**	0.871**	0.892** (33)	0.912** (33,35)	0.919* (33,35,38)	0.927* (33,35,38, 39)	0.939 (33,35,38, 39,42)
1981	1.38	0.466	1.54**	1.96*	0.827**	0.899**	0.901** (33)	0.910** (33,35)	0.915** (33,35,38)	0.926* (33,35,38, 39)	0.940 (33,35,38, 39,36)
1982	1.29	0.449	1.67**	2.89**	0.819**	0.888**	0.891** (33)	0.898** (33,38)	0.907** (33,38,35)	0.922* (33,38,35, 42)	0.942 (33,38,35, 42,39)
1983	1.21	0.362	1.90**	3.81**	0.800**	0.882**	0.900** (33)	0.919* (33,35)	0.941 (33,35,38)		
1984	1.21	0.321	2.05**	4.43**	0.775**	0.853**	0.879** (33)	0.899** (33,38)	0.922* (33,38,35)	0.953 (33,38,35,39)	

** significant at 1 % level, * significant at 5 % level
(20) firm n:o 20 (see Appendix 3) removed from the right tail of the distribution, etc.
[26] firm n:o 26 (see Appendix 3) removed from the left tail of the distribution, etc.

Table 2.11 *Descriptive statistics and test for normality of the distributions of inventory turnover*

Inventory turnover (IT)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	10.10	997.	5.93**	36.41**	0.256**	0.433**	0.647** (42)	0.925* (42,41)	0.951 (42,41,35)		
1975	12.23	2278.	6.24**	39.44**	0.219**	0.385**	0.699** (42)	0.923* (42,41)	0.940 (42,41,35)		
1976	9.40	946.	6.19**	38.99**	0.241**	0.439**	0.793** (42)	0.911** (42,41)	0.932* (42,41,35)	0.953 (42,41,35,26)	
1977	8.49	579.	5.96**	36.75**	0.267**	0.466**	0.736* (42)	0.944 (42,41)			
1978	7.34	204.	4.37**	18.97**	0.359**	0.531**	0.583** (42)	0.927* (42,41)	0.946 (42,41,35)		
1979	7.69	229.	4.49**	20.30**	0.347**	0.505**	0.558** (42)	0.924* (42,41)	0.956 (42,41,35)		
1980	8.44	417.	5.31**	29.67**	0.295**	0.445**	0.545** (42)	0.903** (42,41)	0.918* (42,41,35)	0.941 (42,41,35,33)	
1981	6.95	149.	4.32**	18.42**	0.362**	0.520**	0.564** (42)	0.926* (42,41)	0.949 (42,41,33)		
1982	5.97	63.	3.99**	15.90**	0.433**	0.601**	0.654** (41)	0.906** (41,42)	0.946 (41,42,33)		
1983	5.95	62.	4.37**	20.32**	0.427**	0.600**	0.699** (41)	0.903** (41,42)	0.942 (41,42,33)		
1984	6.64	97.	4.31**	18.76**	0.388**	0.546**	0.607** (41)	0.920* (41,42)	0.955 (41,42,33)		

Table 2.12 *Descriptive statistics and test for normality of the distributions of accounts receivable turnover*

Accounts receivable turnover (ART)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	8.96	26.8	1.73**	4.30**	0.861**	0.946					
1975	8.68	23.8	1.68**	4.09**	0.870**	0.955					
1976	8.61	25.1	1.93**	5.91**	0.861**	0.963					
1977	8.00	17.6	1.42**	3.45**	0.908**	0.976					
1978	7.73	18.3	1.63**	4.47**	0.890**	0.972					
1979	7.87	19.2	1.42**	3.28**	0.902**	0.972					
1980	7.80	16.5	0.82*	0.43	0.939*	0.977					
1981	7.93	17.3	1.48**	4.48**	0.909**	0.975					
1982	7.89	18.4	2.21**	8.85**	0.839**	0.945					
1983	7.42	10.8	0.61*	0.04	0.956	0.977					
1984	7.49	12.2	1.01**	1.09	0.919**	0.962					

** significant at 1 % level
* significant at 5 % level
(42) firm n:o 42 (see Appendix 3) removed from the right tail of the distribution, etc.

Table 2.13 *Descriptive statistics and test for normality of the distributions of total assets turnover (industrial companies)*

Total assets turnover (TAT) (Industrial companies)					**Shapiro - Wilk's W-test statistics**						
					Raw data	**Square-root transformation** Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	1.14	0.164	1.33**	2.27**	0.900**	0.947					
1975	1.01	0.133	1.06**	1.68*	0.939	0.979					
1976	1.03	0.180	1.88**	5.94**	0.859**	0.936					
1977	1.04	0.136	0.90*	0.85	0.934	0.966					
1978	1.03	0.124	1.66**	4.77**	0.876**	0.935					
1979	1.07	0.089	0.74*	-0.02	0.927*	0.942					
1980	1.12	0.096	0.65	-0.68	0.918*	0.935					
1981	1.11	0.099	0.78*	0.07	0.938	0.962					
1982	1.03	0.094	0.69*	-0.11	0.942	0.965					
1983	0.97	0.055	0.14	-0.56	0.984	0.984					
1984	0.99	0.048	0.32	-0.50	0.967	0.971					

Table 2.14 *Descriptive statistics and test for normality of the distributions of total assets turnover (trade and transport companies)*

Total assets turnover (TAT) (Trade and transport companies)					**Shapiro - Wilk's W-test statistics**						
					Raw data	**Square-root transformation** Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	2.32	1.186	0.827	0.393	0.934	0.969					
1975	2.31	1.237	0.528	0.198	0.962	0.978					
1976	2.25	1.186	-0.044	-0.142	0.961	0.947					
1977	2.19	0.869	-0.451	-0.276	0.943	0.911					
1978	2.13	0.769	-0.228	-0.471	0.959	0.938					
1979	2.30	0.843	-0.360	0.187	0.961	0.925					
1980	2.29	0.724	-0.127	-0.703	0.954	0.948					
1981	2.35	0.599	-0.310	-0.102	0.952	0.928					
1982	2.21	0.679	-0.100	0.646	0.896	0.876					
1983	2.05	0.582	0.101	0.091	0.981	0.975					
1984	1.98	0.575	0.269	-0.410	0.977	0.976					

** significant at 1 % level
* significant at 5 % level

Table 2.15 *Descriptive statistics and test for normality of the distributions of inventory turnover (industrial companies)*

Inventory turnover (IT) (Industrial companies)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	3.56	2.18	0.92*	0.70	0.927*	0.961					
1975	3.18	2.45	1.71**	4.19**	0.857**	0.937					
1976	3.35	3.41	2.50**	9.08**	0.786**	0.906*	0.972 (26)				
1977	3.45	2.09	0.80*	0.42	0.941	0.972					
1978	3.64	2.32	1.40**	2.45**	0.893**	0.953					
1979	3.80	1.83	1.16**	1.98*	0.922*	0.964					
1980	3.80	1.87	1.79**	5.21**	0.848**	0.912*	0.928* (11)	0.934 (11,8)			
1981	3.70	1.41	1.09**	1.80*	0.934	0.970					
1982	3.62	1.44	0.64	0.26	0.953	0.973					
1983	3.71	1.13	0.44	-0.47	0.956	0.967					
1984	3.98	1.32	0.70*	0.25	0.942	0.966					

Table 2.16 *Descriptive statistics and test for normality of the distributions of inventory turnover (trade and transport companies)*

Inventory turnover (IT) (Trade and transport companies)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	33.4	4197.	2.76**	7.77**	0.531**	0.674**	0.768* (42)	0.977 (42,41)			
1975	44.4	9887.	2.92**	8.63**	0.469**	0.590**	0.744** (42)	0.977 (42,41)			
1976	30.9	4048.	2.92**	8.60**	0.484**	0.625**	0.873 (42)				
1977	26.4	2423.	2.80**	7.95**	0.531**	0.680**	0.824 (42)				
1978	20.5	761.	1.72**	1.59*	0.651**	0.729**	0.681** (42)	0.965 (42,41)			
1979	21.5	865.	1.80**	2.10**	0.646**	0.716**	0.663** (42)	0.948 (42,41)			
1980	25.0	1684.	2.36**	5.53**	0.590**	0.686**	0.657 (42)	0.925 (42,41)			
1981	18.5	548.	1.69**	1.38*	0.646**	0.717**	0.661** (42)	0.935 (42,41)			
1982	14.3	210.	1.54**	0.82	0.714**	0.808*	0.796* (41)	0.948 (41,42)			
1983	13.9	212.	1.87**	2.85**	0.708**	0.795*	0.797* (41)	0.917 (41,42)			
1984	16.1	349.	1.72**	1.70*	0.677**	0.751**	0.716** (41)	0.916 (41,42)			

** significant at 1 % level
* significant at 5 % level
(26) firm n:o 26 (see Appendix 3) removed from the right tail of the distribution, etc.

Table 2.17 *Descriptive statistics and test for normality of the distributions of accounts receivable turnover (industrial companies)*

Accounts receivable turnover (ART) (Industrial companies)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	8.81	31.9	1.76**	3.98**	0.842**	0.936					
1975	8.37	26.5	1.81**	4.57**	0.848**	0.945					
1976	8.34	28.6	2.10**	6.35**	0.830**	0.948					
1977	7.66	19.2	1.66**	4.41**	0.879**	0.965					
1978	7.38	20.6	1.86**	5.22**	0.853**	0.954					
1979	7.55	21.7	1.64**	3.82**	0.867**	0.957					
1980	7.54	18.5	0.97*	0.62	0.918*	0.970					
1981	7.68	20.1	1.66**	4.65**	0.884**	0.968					
1982	7.72	21.5	2.37**	8.85**	0.807**	0.930*	0.966 (20)				
1983	7.16	11.8	0.90*	0.42	0.917*	0.957					
1984	7.10	10.8	1.14**	1.41*	0.900**	0.948					

Table 2.18 *Descriptive statistics and test for normality of the distributions of accounts receivable turnover trade and transport companies)*

Accounts receivable turnover (ART) (Trade and transport companies)					Shapiro - Wilk's W-test statistics						
					Raw data	Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis		0	1	2	3	4	5
1974	9.49	9.97	1.057*	0.206	0.860	0.862					
1975	9.78	14.58	1.725**	3.857**	0.847	0.909					
1976	9.57	13.10	1.014*	1.202*	0.910	0.941					
1977	9.23	11.31	0.740	-0.695	0.895	0.915					
1978	8.98	9.41	0.843	0.283	0.933	0.956					
1979	9.01	9.95	0.349	-0.118	0.976	0.984					
1980	8.72	9.72	0.478	-0.517	0.951	0.960					
1981	8.85	7.19	0.132	-0.452	0.951	0.949					
1982	8.48	7.93	-0.239	-0.869	0.935	0.949					
1983	8.35	7.01	-0.943*	0.567	0.912	0.871					
1984	8.90	16.18	0.712	1.944**	0.935	0.953					

** significant at 1 % level
* significant at 5 % level
(20) firm n:o 20 (see Appendix 3) removed from the right tail of the distribution, etc.

Appendix 3 *List of the firms in the study*

Industrial companies

1 Oy W. Rosenlew Ab
2 Enso-Gutzeit Oy
3 G.A. Serlachius Oy
4 Kymi-Strömberg Oy
5 Nokia Oy Ab
6 Oy Wilh. Schauman Ab
7 Rauma-Repola Oy Ab
8 Yhtyneet Paperitehtaat Oy
9 Oy Lohja Ab
10 Oy Partek Ab
11 Huhtamäki Oy
12 Suomen Sokeri Oy
13 Rettig
14 Marimekko Oy
15 Oy Finlayson Ab
16 Tamfelt Oy Ab
17 Lassila & Tikanoja Yhtymä Oy
18 Suomen Trikoo Oy Ab
19 Kajaani Oy
20 Kemi Oy
21 Metsäliiton Teollisuus Oy
22 Oy Kaukas Ab
23 Amer-Yhtymä Oy
24 Otava
25 Werner Söderström Oy
26 Farmos-Yhtymä Oy
27 Medica-Yhtymä Oy (CON)
28 Oy Wärtsilä Ab
29 Fiskars Oy Ab
30 Instrumentarium Oy
31 Kone Oy
32 Oy Tampella Ab

Trade and transport companies

33 Kesko Oy
34 Rake Oy
35 Talous-Osakekauppa
36 Oy Ford Ab
37 Finvest Oy
38 Oy Tamro Ab
39 Oy Stockmann Ab
40 Kuusinen Oy
41 Effoa - Suomen Höyrylaiva Oy
42 Tietotehdas Oy

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