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CROSS-SECTIONAL PROPERTIES AND TIME-SERIES PERSISTENCE OF FINANCIAL RATIO DISTRIBUTIONS

Empirical Evidence with Finnish Data*

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1. INTRODUCTION

1.1. Background

The analysis and use of financial ratios is an increasingly important area of accounting research and practice. Parties demanding financial statement information are investors, managers, employees, lenders, customers, and government. The demand for financial statement information is derived from the target to improve the decision making (see e.g. Foster 1986:9). Two different principal uses of financial ratios are identified. The first one 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, the way how to give those standards, e.g. how to aggregate industry-wide averages of the financial ratios, seems to be very important. The results found by Yli-Olli and Virtanen strongly support the use of value-weighted averages instead of equal-weighted averages (see Yli-Olli and Virtanen 1989). 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 or by lending institutions to forecast corporate failure or by management to forecast cash flow or earnings (see Whittington 1980 and Barnes 1987).

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

When using financial ratios, it is important to realize 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: 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 strict proportionality between numerator and denominator (Foster 1986: 96-98). Another interesting question is the existence (or non-existence) of the constant term in computing the ratios (McDonand and Morris 1984: 90 and Yli-Olli and Virtanen 1985: 14-17). However, maybe the most important findings in recent empirical papers are those of non-normal distributions of financial ratios (Lev and Sunder 1979). That finding is important to both practitioners and

researchers. The normal distribution is very practical because the mean and standard deviation are sufficient to characterize the whole distribution. In addition, many statistical tools presuppose normally distributed variables.

1.2. Previous research

During the last decade a growing interest has risen to analyze the distributional properties of financial ratios. In the seminal work in financial ratio analysis Horrigan (1965) found that some financial ratios tended to be normally distributed but that there also was some evidence of positive skewness across many ratios. Pinches, Eubank, Mingo and Caruthers (1975) found considerable skewness in the financial ratio distributions. A logarithmic transformation improved normality, reduced outliers and improved homoscedasticity of the distributions. Deakin (1976) analyzed 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 data. The applied transformations were square-root and logarithmic transformations.

Foster (1978:70) suggested first that the treatment of outliers is an important problem in ratio analysis. Lev and Sunder (1979) analyzed the problem of outliers very carefully. They confirmed 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 a value of an outlier to that of the closest non-outlier; see Lev and Sunder 1979: 207). They also suggested that equally-weighted averages as estimates of industry standards will be more sensitive to outliers than value-weighted averages. The results by Yli-Olli and Virtanen (1985) strongly confirmed the 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. After using square-root transformations, deleting some few outliers and specific industry grouping they achieved dramatic changes in the shapes of distributions. Normality or approximately 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 distributional properties of financial ratios

In Section 1.1 we mentioned two principal uses of financial ratios. The first was the use of the ratio as an industry-wide target value for the firms (how to compute indusry-wide norms for firms). The second was the use of the ratios for predictive purposes (different statistical and econometric methods suppose different assumptions about distributions). In both cases it is important to know the distributional properties of the ratios.

We have a lot of empirical research which examines whether a normal distribution can be used to describe financial ratios or which makes attempts to transform the data such that a normal distribution assumption is descriptive. Maybe more attention has to be paid in future to the theoretical features and also empirical interpretations of the financial ratios. That means we have to analyze theoretically what kind of distributions a priori will best describe different ratios. After that we have to decide 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 them symmetry (e.g. the current ratio and quick ratio have a technical lower limit of zero, see e.g. Foster 1986: 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 an equal increase in the denominator, see e.g. Frecka and Hopwood (1983: 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: 338).

After theoretical analysis we can better make hypotheses concerning whether it is reasonable to use different transformations to get data such that normal distribution assumption is descriptive. Theoretical analysis shows what kind of transformations a priori seem to give the best results. In addition, theoretical analysis gives us advice for empirical interpretations. This is important especially in the case 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 analyze the cross-sectional properties of the selected financial ratios by examining if those ratios are normal: 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 try to analyze if the observed extreme values are true outliers.

2. To analyze time series behaviour of the ratios' cross-section. Especially how the cross-sections of the selected ratios behave during different business cycles.

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 1974:28, Foster 1978: 28 and Tamari 1978: 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 also the ratios themselves are illustrative rather than exhaustive. For example, many popular market based ratios such as earnings per share (EPS) and prise per earnings (P/E) are excluded. For our selection we have two preliminary reasons. First, we will compare the results of this study to those by Yli-Olli and Virtanen (1985). In that study we had the same ratios as in this study. The previous research gave interesting hypotheses concerning the importance of extreme values to some selected ratios. This is a very important reason in spite of those results also showed that the empirical classification of the selected ratios was not exactly the same as a priori classification, i.e. that presented in textbooks. Second, we will reserve the possibility to compare our results to those by Buijink and Jegers (1986) from Belgium. They had in their research eleven of the twelve ratios presented e.g. by Foster (1978) and used by Yli-Olli and Virtanen (1985), and also adopted in this study.

Before going to the empirical work we first try to analyze theoretically if a normal distribution could, a priori, be valid to describe the selected financial ratios before deleting extreme values or before any other transformation of 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. Then, positive skewness of the original variables seems to be obvious.

In the second category there are 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. Then also the original values of those variables seem, 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 it as a measure of profitability which has been deflated by the interest rate. Also our earlier empirical results confirm this interpretation (Yli-Olli and Virtanen 1985: 40, 44 and 47). When the numerator of this ratio is negative we have no economic interpretation for the ratio. Therefore, in practice, also the numerical values of this ratio are 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 normally have "large" (and positive) denominators compared to respective 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 without economic interpretation. A priori we suppose 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). Due to the population used in the study (including in principle all firms quoted on the Helsinki Stock Exchange except banks and insurance companies), the distributions of the efficiency ratios would be non-normal if the relation between sales and equity, the inventory policy, or the efficiency of the credit department 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 are calculated using the definitions presented by Foster (Foster 1978: 43-44) and calculating the basic financial items according to the recommendations by Yritystutkimusneuvottelukunta (1983).

In order to determine the stability of the observed distributions the analysis using the same firms will run for eleven different cross-sections. Especially we will look if we can find differences in the disributions during different business cycles.

3. METHODOLOGY

The methodological interest in studies of financial ratio distributions is typically focused on four different issues: (i) assumptions or hypotheses concerning the distribution of the raw data, (ii) use of transformations to achieve a desired result, e.g. normality, for non-acceptable raw data distributions, (iii) choice of an appropriate and powerful statistical test for testing the type of ratio distributions (before and after transformations), and (iv) detection and removal of outliers from the main body of the distribution.

In the following, we present a brief discussion about each of the problem areas above and introduce the choices made for this study.

3.1. Distribution family approach

In the earliest studies on ratio distributions only normality vs. non-normality of the distributions was tested, i.e. the normal distribution was the only hypothetized statistical model for the raw data (see e.g. Horrigan 1965, O'Connor 1973, Deakin 1976, and Bird and McHugh 1977). As the number of studies on the subject increased, a general conclusion could be made that the normal distribution was not a tenable representative for most of the ratio distributions (for a good summary of common observations in these distribution studies, see Ezzamel, Mar-Molinero and Beecher 1987). Positive skewness and prevalence of extreme outliers were the main reasons affecting deviation from normality.

Due to the fact that a majority of ratio distributions tend to be positively skewed and thus non-normal, many other statistical models have been introduced in the literature to describe the cross-sectional behaviour of financial ratios. Among others the lognormal distribution (Fieldsend, Longford and McLeay 1987) and the family of stable Paretian distributions (So 1987) have been used as models for raw ratio distributions.

The most promising approach for choosing a model for financial ratios seems to be the gamma distribution family approach. Of particular importance is that the gamma distribution is appropriate for both skewed and symmetric distributions, and it is also suitable when dealing with outliers (Barnett and Lewis 1978: 76, Frecka and Hopwood 1983: 117, and Ezzamel, Mar-Molinero and Beecher 1987: 469). This distribution contains as its special cases the exponential, the chi-square, and the normal distributions. Thus, the shape of the gamma distribution is very versatile, ranging from extremely skewed distributions (as the exponential one) via moderately skewed (i.e. the chi-square) distributions to symmetric and approximately 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:

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

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

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

Frecka and Hopwood (1983: 118) give examples of different shapes of the gamma distribution for selected values of α and β. One can see that the combination $\alpha = 1$, $\beta = 1$ generates the exponential distribution, the combination $\alpha = 2$, $\beta = 1$ produces a chi-square distribution, and an approximately normal distribution can be achieved e.g. by choosing $\alpha = 4$, $\beta = 1$.

There exists much empirical evidence that the main body of a ratio distribution (i.e. the raw distribution with possible outliers removed) follows either the normal or a positively skewed distribution (for a summary, see Ezzamel, Mar-Molinero and Beecher 1978: 464-466). This type of ratio behaviour can be argumented also theoretically (Frecka and Hopwood 1983: 117, Buijink and Jegers 1986: 338). The gamma distribution is thus in good accordance with both empirical and theoretical reasoning on raw data behaviour. As there, in addition, exists another theoretical argument in favour of the use of gamma distribution as a model for the ratio distribution (this will be considered in the next section), the gamma distribution family approach has been adopted in this study.

3.2. Square-root transformation

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

Both natural logs and square roots suffer from the defect that they cannot be applied if the ratios are negative (whereas cube-root transformation can also be used for negative values). This difficulty can be avoided, however, by adding a small constant to the ratio. For ratios which exceed one all the above transformations work alike each others, 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 "overtransform" the data: instead of positive skewness in the raw data one obtains negative skewness in the transformed data.

There is no unanimous empirical evidence what transformation technique should be preferred. Results supporting the use of square-root transformation seem, however, to be in a majority (see e.g. Deakin 1976: 93-95, Ezzamel, Mar-Molinero and Beecher 1987: 474-479). The most important support for the square-root transformation comes from its consistency with the underlying gamma distribution theory. For, if the raw data follows a gamma distribution with parameters α and β (cf. equation (1) above), then the square-root transformed data is approximately distributed as a normal random variable with mean $(\beta(\alpha-1/4))^{1/2}$ and variance $\beta/4$ (Barnett and Lewis 1978: 88, Frecka and Hopwood 1983:118-119). This means that, after applying a square-root transformation, normality for data is expected and a statistical test based upon the normal distribution becomes appropriate. For reasons noted above, the square-root transformation technique is preferred in this study.

3.3. Shapiro - Wilk's normality test

Several tests have been employed in the literature to test the normality of a distribution (before or after transformation). The most common tests applied are the chi-square (χ^2) goodness-of-fit 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: 102).

The χ^2 test is based on assymptotic theory and is, therefore, not appropriate in our small sample study. The test also has the disadvantage that it uses aggregation of data: the number and character of class intervals used are arbitrary. On the other hand, for large samples the χ^2 test has shown good power against highly skewed distributions and reasonable sensitivity to very long tailedness (Ezzamel, Mar-Molinero and Beecher 1987: 473).

The Kolmogorov - Smirnov test and the Lilliefors test treat observations separately and thus information loss resulting from aggregation of categories is avoided. Moreover, the tests are distribution free and suitable to small samples (Siegal 1956, Lilliefors

1976). The power and sensitivity to non-normality of these Kolmogorov - Smirnov type distance tests is not, however, especially high. They are typically outperformed by the Shapiro - Wilk test (Shapiro and Wilk 1968).

The Shapiro - Wilk test is an effective test for normality even for 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.

3.4. Outliers

Besides skewness, also the presence of extreme outliers can affect for a distribution a considerable departure from normality (Deakin 1976, Bougen and Drury 1980, Frecka and Hopwood 1983, Ezzamel, Mar-Molinero and Beecher 1987). Trimming the data (i.e. segregating outliers by reference to a prescribed and well-known distribution) and winsorising (changing an outlier's value to that of the closest non-outlier) are suggested truncation techniques (Barnes 1978: 451).

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

4. EMPIRICAL RESULTS

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

We will also analyze how the cross-sectional distributions of the selected ratios behave during different business cycles. The Finnish economy is very open. During the period examined the Finnish foreign trade was about 30 percent from the gross domestic product (on an average). At the beginning of the period the inflation in Finland was over 10 percent. The Finnish firms lost very rapidly their competitiveness both abroad and in Finland. The Finnish mark was devaluated in 1977. Figure 1 presents the index which describes the Finnish firms' competitiveness during the period examined.

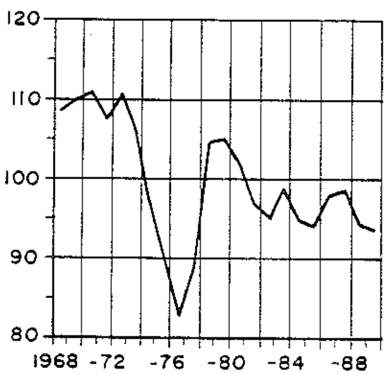

Figure 1. The Finnish firms' competitiveness (relative unit labour costs of OECD/Finland).

Tables 1-3 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, without transformation positively skewed. However, even the raw data for quick ratio is normally distributed during the years 1977-1979. The square-root transformed data makes a better fit with the normal distribution for the liquidity ratios. In the case of the quick ratio, the transformation of the data makes distributions normal in all the years examined. After removing not more than two observations from the sample the square-root transformation also normalizes the distributions of the current ratio and defensive interval measure. However, although we know that the removed firms are very profitable firms we can not identify them to be true outliers.

The removed firms are not identical in the cases of current ratio and defensive interval measure. This supports the results presented by Yli-Olli and Virtanen in 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).

Table 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. 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 the Appendix) removed from the right tail of the distribution, etc.

Table 3. Descriptive statistics and test for normality of the distributions of defensive interval measure.

Defensive interval (DI)					Shapiro - Wilk's W-test statistics						
						Square-root transformation, Number of removed oudliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	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 4. Descriptive statistics and test for normality of the distributions of debt to equity.

Debt to equity (DE)					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	2.53	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
(23) firm n:o 23 (see the Appendix) removed from the right tail of the distribution, etc.

Table 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 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 the Appendix) removed from the right tail of the distribution, etc.
[40] firm n:o 40 (see the Appendix) removed from the left tail of the distribution, etc.

Figure 1 and Tables 1-3 show that when the competitiveness for Finnish firms is high there are positive outliers in the distributions of the liquidity ratios. Respectively, when the competitiveness becomes weaker the outliers seem to disappear. At the same time the variances of the distributions become smaller. We can interpret this so that during the boom some Finnish firms maintain very "good" liquidity but during the recession they must diminish it. On the other hand, all the firms must keep their liquidity on a certain minimum level. Therefore the variance of the liquidity measures is larger during the boom and there are also some positive outliers. The outliers differ from each other depending on the measure of the liquidity.

Tables 4-6 show the cross-sectional distributions of the long-term solvency ratios. According to our a priori hypotheses, also all the long-term solvency ratios are supposed to have positively skewed distributions. The reason is technical. They have a lower limit of zero. It is in the case of defensive interval measure we have similar situation. We have no economic interpretation for the negative values of the ratios. In addition, the ratios where numerator is large in comparison with denominator tend to produce positively skewed distributions.

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

The Finnish firms' competitiveness was very weak during the years 1975-77. During these years, the ratio debt to equity has many outliers. The profitability of these firms was extremely low during those years (most of them are firms in a forest industry). The debt to equity ratio follows the firms' competitiveness index. The lag is one or two years. When the firms' competitiviness index is lowest the mean and variance of the ratio are, with a lag of two years, highest, and we also have the largest amount of outliers (which all are very unprofitable firms). It is interesting to find that changes in the competitiviness index are reflected very clearly in the distributions of the liquidity ratios (especially) current ratio, and in those of the long-term solvency ratios debt to equity and long-term debt to equity. It can be clearly seen especially in the outliers of the ratios.

When we analyze the long-term debt to equity ratio we find that the lag of this ratio to competitiveness index is about four years. During these years, the short-term debt was more expensive than the long-term debt. During the years 1975-1978 it was not

possible to get more long-term debt for very unprofitable firms (the outliers in debt to equity). When the firms' competitiveness became better, they could change their short-term debt to long-term debt. The lag was about two to three years from the year the competitiveness index was lowest. The outliers disappeared from the ratio debt to equity and the same outliers appeared into the ratio long-term debt to equity.

The distributions of the third long-term solvency ratio (times interest earned) differ a bit from the distributions of the two others. The results presented by Yli-Olli and Virtanen (1989) show that the times interest earned ratio in fact is a profitability measure rather than a long-term solvency ratio. The ratio is calculated as earnings before interest and taxes deflated by interest payments. All the outliers in parentheses ( ) are very profitable firms and those in brackets [ ] very unprofitable ones.

Tables 7-9 show the cross-sectional distributions of the profitability ratios. We supposed, a priori, that profitability ratios are normally distributed, because they are technically "ideal" financial ratios. However, a very common used ratio, earnings to sales, is theoretically not a good profitability measure. Its numerator is earnings after extra items, which amount "belongs" to equity. The denominator sales "belongs" to both liabilities and equity. A better nominator for this ratio should be e.g. earnings before interest and taxes. That is the case especially in Finland where liabilities are almost for all firms a larger amount than equity.

We found that the distribution of the raw data for earnings to sales is normally or almost normally distributed. During the recession when the competitiviness of Finnish firms was very weak there were some outliers. When the competitiviness is weak outliers are as a rule negative (the distribution is skewed to the left) and belong thus to very unprofitable firms. The square-root transformation does not change the results essentially. Some years the transformed data was a bit closer to normal and some years the raw data was more normally distributed. Therefore we do not present transformed data for profitability ratios. After removing not 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 is mildly positively skewed according to Shapiro-Wilk's test (1975, 1976 and 1979). In addition, the distribution seems to be skewed very slightly to the left during the years 1977 and 1978. There are some firms for which it took more time to improve their results after devaluation of Finnish mark in 1977.

Table 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 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 the Appendix) removed from the right tail of the distribution, etc.
[28] firm n:o 28 (see the Appendix) removed from the left tail of the distribution, etc.

Table 9. Descriptive statistics and test for normality of the distributions of return on equity.

Return on equity (ROE)					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	0.148	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 10. Descriptive statistics and test for normality of the distributions of total assets turnover.

Total assets turnover (TAT)					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	1.40	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 the Appendix) removed from the right tail of the distribution, etc.
[26] firm n:o 26 (see the Appendix) removed from the left tail of the distribution, etc.

Table 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 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 the Appendix) removed from the right tail of the distribution, etc.

The distributions for the return on equity are very similar to those for the return on assets. However, 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. The distribution is a bit skewed to the left. It is very interesting to find that firm number 6 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 the most one or two outliers the distribution becomes normal for every year. According to our a priori hypotheses the distributions of the profitability ratios are normal even without any transformation.

Tables 10-12 show the cross-sectional distributions for the efficiency ratios. Efficiency ratios are the most heterogeneous group of the selected ratios for this study. In addition, the numerical values of the efficiency ratios are so high that we can a priori suppose positively skewed distributions (see Frecka and Hopwood 1983: 117). The raw data for all efficiency ratios - total assets turnover, inventory turnover and accounts receivable turnover - is 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. It means that terms of payment and also payment policies are very similar for all Finnish firms.

When we analyzed 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 13 and 15 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 14 and 16, respectively. For industrial companies, the distributions of raw data remain positively skewed. However, the square-root transformation changes the distributions normal. There are two exceptional years for inventory turnover where we have a slight positively skewed distributions. After removing one or two outliers the distributions become normal. The situation is almost similar for trade and transport companies. Even raw data without transformation for total assets turnover is normally distributed. After removing two outliers also the transformed data of inventory turnover becomes normal.

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

Table 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						
						Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	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 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						
						Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	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 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						
						Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	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 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						
						Square-root transformation Number of removed outliers					
Year	Mean	Variance	Skewness	Kurtosis	Raw data	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 the Appendix) removed from the right tail of the distribution, etc.

Table 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 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 the Appendix) removed from the right tail of the distribution, etc.

5. SUMMARY

The purpose of this study was to analyze the cross-sectional distributions of the selected twelve financial ratios. The 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 1989) and Buijink and Jegers (1986) have used the same ratios in their earlier researches.

We found that according to our a priori hypotheses, the distributions of all the liquidity ratios were, without transformation, positively skewed. The square-root transformation made the distributions normal. The quick ratio was normal without deleting any outliers from the sample. After removing some outliers from the transformed data also current ratio and defensive interval became normal. We also found that the changes in the competitiveness of Finnish firms strongly affect the distributions of the ratios. During the recession outliers disappeared and the variance of the distributions became smaller. During the boom there appeared some outliers. The reason for it is that the liquidity of the firms has a certain minimum lower limit but no clear upper limit.

The distributions of the long-term solvency ratios were also, without transformation, positively skewed according our a priori hypotheses. The square-root transformation and deleting some outliers made long-term solvency ratios normally distributed. We also found that the outliers of the ratios debt to equity and long-term debt to equity strongly depend on the competitiveness of the Finnish firms. The lag for the variable debt to equity is one or two years and for the variable long-term debt to equity about two years. When competitiveness had been very low and it was improving, after two years there appeared outliers in the distribution of the variable debt to equity. When the profitability of those firms had improved they could change they short-term debt into cheaper long-term debt and the firms become outliers in the distribution of long-term debt. It took about four years from the bottom of the recession.

The distributions of the third long-term solvency ratio, times interest earned, behaved like the distributions of the profitability ratios. In fact in the Finnish data (very levered firms) this variable is a measure of profitability. Earnings before interest and taxes are deflated by interest payments. The results confirm the earlier results by Yli-Olli and Virtanen (1989).

The profitability ratios among the selected ratios are ideal in the respect that we can a priori suppose that the distributions are normal without any transformation. The empirical results confirmed this hypothesis.

Finally, we analyzed the efficiency ratios. We concluded a priori that the efficiency ratios are the most heterogenenous 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.

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APPENDIX: 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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