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ON INFORMATION BASED DECOMPOSITION MEASURES IN FINANCIAL STATEMENT ANALYSIS

by

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1 Introduction

This paper deals with the use and interpretation of decomposition measures based on the concept of entropy in financial statement analysis. The application is connected with the interpretation of entropy as a measure of dispersion. The correlations between decomposition measures and sixteen financial ratios are analyzed. Decomposition measures spanning over several years are also studied in sections 4 and 5. The data utilized is for the period 1970 - 1980 and includes fifteen finnish firms.

Entropy can be interpreted as a measure of dispersion which due to the general nature of definition, can be used in the analysis of various variables. Entropy has been used in economics when studying, for example, the structure of markets, centralization of industry and when testing different statistical hypotheses. In these applications, entropy is considered primarily as a measure of dispersion.

The use of entropy originated in physics where changes in the states of thermodynamic systems are described with the help of entropy. A general law describing the direction of thermal energy flows (the second law of thermodynamics) can be defined with entropy.

Entropy also is an important concept in information theory where it can be used as a tool for matching information streams with channel capacities. The mathematical expression of entropy is also based on information theory. However, information theory is primarily a theory connected with statistical probabilities of different combinations of signals and as such it is not associated with economics.

The thermodynamic and information theoretic interpretations of entropy have unfortunately been often the reason for misunderstanding of the relevance of entropy in economics.

2 Definitions and properties of entropy

In statistics entropy is a measure of dispersion for qualitative data. For a qualitative variable X, the value of the variable may be quite arbitrary. The whole information is in the class frequencies or probabilities. In order to get a dispersion index for the distribution, only these probabilities can be used (Astola and Virtanen 1981).

Consider the frequency distribution of a qualitative variable X.

Table 1.

classes	relative frequencies
E_1	p_1
E_2	p_2
.	.
.	.
E_N	p_N

$$\sum_{i=1}^{N} p_i = 1$$

The entropy of variable X is now defined as

$$H = -k \sum_{i=1}^{N} p_i \log p_i \quad . \tag{2.1}$$

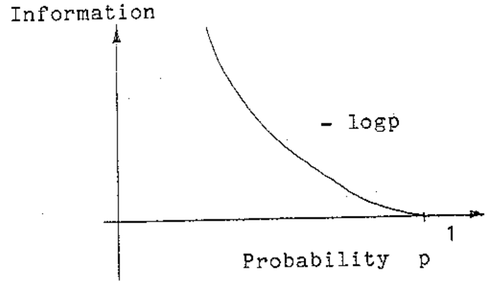
The coefficient k can be chosen according to the base of the logarithm to be used. In general logarithms with base 2, widely employed in information theory, are used. The unit of entropy is then called a "bit". When natural logarithms are used, the unit is called a "nit".

On the basis of the definition the following properties can be noted.

1. H is non-negative.
2. H = 0 only if one $p_i = 1$ (and all other $p_i = 0$).
3. H depends only on frequencies (probabilities).
4. H reaches maximum value logN when $p_1 = p_2 = .. = p_N = 1/N$.
5. H can be decomposed within and between entropies.

Definition (2.1) derives from the mathematical information theory the following sense. It is assumed that the information received from a specific event can be expressed as a monotonically decreasing function of the probability of the event. The negative logarithm function fulfils this requirement.

Figure 1



Consequently, if the event is "certain" the information received equals zero, while the information of a rare event would be high. The expected information can thus be defined according to equation (2.1).

Also other measures can be derived from information theory (Kullback 1966, 5-10). Consider there is a prior information $-\log q_i$ from an event to be examined. If, however, posterior probability p_i is observed, the information received from the transformation prior probability q_i to p_i can be expressed by the difference

$$(2.2) \qquad \log(1/q_i) - \log(1/p_i) = \log(p_i/q_i) .$$

The expected value of this information is then

$$(2.3) \qquad I(p;q) = \sum_{i=1}^{N} p_i \log(p_i/q_i) .$$

This is often called information inaccuracy. The definition shows that I(p;q) reaches the minimum value 0 when all p and q are equal for all i. I(p;q) can thus be interpreted as a measure of "information inaccuracy".

It can be shown that (2.3) is approximately distributed as the χ^2 -distribution (Kullback 1966, 101-102). Tests can be applied when studying how much the observed distribution differs from the expected one (Hauser 1977). The null hypothesis can be, for example, the homogeneity of groups (Latosaari and Virtanen 1983).

3. Financial statement analysis

The statistical interpretation of entropy makes it possible to analyze structural changes in financial statements. Measures based on definitions of entropy have been suggested for use in structural analyses of financial statements (Theil 1969, Lev 1974, 47-60, Walker etc. 1979) and in prediction of bankruptcy as well as corporation takeovers (Belkaoui 1976). Lev states that with decomposition analysis it is possible to identify whether significant change in financial constructs have occured and,moreover, where most of the change is located. Any structural changes whether planned or unplanned, are of interest to the financial analyst. Changes may indicate changes in management strategy or management's inability to maintain a desired structure (Walker etc. 1979, 173-174).

The definition (2.3) with its properties suits well the approach concerned. The measure receives high values when changes are observed in successive relative proportions.

The decomposition measure can be calculated for the income statement (on certain conditions) and for the balance sheet as a whole or any combination of account balances. In general, the measure has been employed for the whole balance sheet (BSDM), for assets (ADM) and liabilities (LDM).

The categories of the balance sheet are divided in both assets and liabilities into three classes. If p_{ij} is the relative proportion of the sum of assets when j = 1 and liabilities when j = 2, then the six classes sum to unity.

$$(3.1) \qquad \sum_{i=1}^{3} \sum_{j=1}^{2} p_{ij} = 1 \qquad (3.2) \qquad \sum_{i=1}^{3} p_{i1} = 0.5$$

$$(3.3) \qquad \sum_{i=1}^{3} p_{i2} = 0.5 \quad .$$

(3.2) is the sum of assets and (3.3) the sum of liabilities

Balance sheet proportions

	assets	liabilities	
Quick assets	p_{11}	p_{12}	Short-term debt
Inventory	p_{21}	p_{22}	Long-term debt
Long-term assets	p_{31}	p_{32}	Net Worth
Total	0.5	0.5	Total

The measures are defined with two balance sheets for different points in time by using Kullback's definition (2.3). If fractions from earlier balance sheet are expressed as q_{ij} and fractions from later balance sheet as p_{ij} then

$$(3.4) \qquad BSDM = \sum_{i=1}^{3} \sum_{j=1}^{2} p_{ij} \log(p_{ij}/q_{ij})$$

$$(3.5) \qquad ADM = \sum_{i=1}^{3} 2p_{i1} \log(2p_{i1}/2q_{i1})$$

$$(3.5) \qquad ADM = \sum_{i=1}^{3} 2p_{i2} \log(2p_{i2}/2q_{i2}) \; .$$

These definitions are based on the decomposition property of entropy. BSDM represents "between" groups and ADM and LDM "within" groups entropies. It can be stated that BSDM is the average of ADM and LDM. The greater the difference between the relative proportions of the earlier and later balance sheets the higher the numerical values of the measures are. The measures indicate only the amount of change, not the direction. It has been found that the decomposition measures are generally larger for small firms than for large firms. Further, it has been found that the LDM is generally larger than the ADM.

Decomposition measures have been suggested for use in the prediction of company bankruptcy. Empirical results indicate that decomposition measures are generally larger for failed than for non-failed firms. It has also been found that decomposition measures have approximately the same predictive power as most of the traditional ratios. The discriminating ability between solvent and bankrupt firms is, however, not fully convincing.

It has also been found that decomposition measures are closely related to changes in company cash flows. The results also show that correlation only occurs between the absolute values of changes and decomposition measures (Ball etc. 1976). Consequently, the measures observed do not indicate whether the changes have been favourable or unfavourable to the firm.

There are thus good grounds for questioning the validity of decomposition measures when evaluating the firm's financial condition. If high measures were interpreted to predict bankruptcy, all structural changes in the balance sheet would be negative phenomena for the firm. Still structural changes are also associated with positive developments as well, so the prediction of bankruptcy by using decomposition measures cannot, at least in theoretical terms, be considered approriate.

The decomposition measures could be used instead for monitoring financial statements for a longer period of time at a general level. If considerable numerical values of measures are observed, the financial statements can be examined closer, and the financial development during the period concerned evaluated with more sophisticated measures. To be able to use decomposition measures in an approriate way in the general evaluation it should be assumed that there is a clear correlation between decomposition measures and financial ratios. This would mean that when observing considerable values of measures, changes in the ratios describing firm's finacial condition could also be expected. This type of correlation has been studied between decomposition measures and the absolute changes in values of usual ratios (Walker etc. 1979). In this research it was found that the BSDM and the LDM are highly correlated to the absolute changes in values of ratios. With regard to the ADM the correlation was smaller.

Discriminant analysis is also widely used for analyzing financial statements. The scores used are not separate measures but linear combinations of measures, such as combination score Z. Also in this case the decomposition measures apparently correlate with the score used, because they correlate with the components of the score. If a reliable discriminant model is in use for the firm monitored, the use of decomposition measures does not give any further information because the changes can be observed by using the combination too.

It sholud be noted, however, that when using combinations the combinations are estimated from specific data. The question is whether the firm monitored is in agreement with the data employed in estimation. Also the stability of linear combinations may be questionable (Aho 1981, 72-114). In these cases, decomposition measures can be calculated to support the evaluation, because they are not dependent on any statistical estimation (Walker etc. 1979).

It should also be observed that any comparing analysis of balance sheets cannot be based on the relative proportions of balance sheet items alone. The decomposition of balance sheet may in some cases vary across the firms examined. However, the properties of decomposition measures make it possibel to compare the structural changes in differently constructed balance sheets as well.

As was earlier mentinoned, decomposition measures could, in principle be defined also for other financial statements For instance for income statement. The practical limitation is the possibility of negative proportions which cannot be handled by the basic definitions. Apparently, the use of decomposition measures in these cases would become too complex.

4. Correlation between financial ratios and decomposition measures

In this section the correlation between decomposition measures and seventeen financial ratios is studied. Fifteen finnish firms are examined in the period of 1970 - 1981. In order to observe gradual structural changes in the same direction, the measures spanning over several years are also studied.

The spearman rank correlation coefficients are calculated between decomposition measures and changes in absolute values of ratios for each firm in the 11 year period. The values presented in the tables are averages of these correlations.

4.1 Decomposition measures spanning one year

Decomposition measures are calculated by the basic definitions (3.4), (3.5) and (3.6). The relative shares p and q are successive relative proportions.

It was observed that LDM is generally larger than ADM as previously reported. Compared between the firms the decomposition measures did not vary very much. In this study the firm sizes were however quite homogeneous and therefore general conclusions about the variability of decomposition measures across the firm size can not be drawn on the basis of this data.

Averages of the correlations are presented in the table 2. The ratios used are

CR	Current ratio
DE	Debt to equity ratio
Kpot	Return on total assets
Lvt	Earnings before int&taxes/sales
Mskn	Trades receivable turnover
Mt	Net income/sales
Omav	Equity to total assets
Opot	Return on equity
Ovkn	Trades payable turnover
Pokn	Total assets turnover
Por1	Total debt to total assets
ROI	Return on investment
QR	Quick ratio
Rt	Cash flow/total assets
Vkn	Inventories turnover
Vpkn	Debt turnover

The D in front of the names in following Tables is for difference in absolute value.

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
ROW VARIABLE NAME=DCR				
BSDM	0.55125369	0.27227669	-0.05454545	0.84242424
ADM	0.22005559	0.31707512	-0.52380952	0.69090909
LDM	0.56230657	0.30962895	-0.13636364	0.90303030
ROW VARIABLE NAME=DDE				
BSDM	0.41784680	0.31386557	-0.28181818	0.90476190
ADM	0.21753346	0.24191312	-0.30000000	0.75380287
LDM	0.45226458	0.30734870	-0.31818182	0.88095238
ROW VARIABLE NAME=DKPOT				
BSDM	0.22417362	0.25754676	-0.82857143	0.43636364
ADM	0.20541842	0.25858482	-0.37142857	0.55454545
LDM	0.09522089	0.30558659	-0.77142857	0.51818182
ROW VARIABLE NAME=DLVT				
BSDM	0.26798544	0.28872129	-0.65714286	0.75454545
ADM	0.24905823	0.23598672	-0.40476190	0.48181818
LDM	0.12884665	0.22754433	-0.20000000	0.60000000
ROW VARIABLE NAME=DMSKN				
BSDM	-0.00832157	0.31697891	-0.52727273	0.56363636
ADM	-0.10960730	0.37852875	-0.74545455	0.63636364
LDM	0.06967828	0.32400033	-0.56363636	0.68484848
ROW VARIABLE NAME=DMT				
BSDM	0.17234598	0.28948067	-0.37142857	0.76363636
ADM	0.08995442	0.30667029	-0.41818182	0.50000000
LDM	0.19084029	0.21106179	-0.24848485	0.49090909
ROW VARIABLE NAME=DOMAV				
BSDM	0.47358692	0.23955645	-0.22727273	0.81438586
ADM	0.22061854	0.24170032	-0.20909091	0.69301232
LDM	0.48113187	0.28072600	-0.33636364	0.89821970
ROW VARIABLE NAME=DOPOT				
BSDM	0.21856598	0.28522388	-0.65714286	0.76363636
ADM	0.12743041	0.23314129	-0.21428571	0.53636364
LDM	0.19561366	0.30257668	-0.65714286	0.60000000
ROW VARIABLE NAME=DOVKN				
BSDM	0.20916941	0.28000360	-0.47878788	0.66869610
ADM	0.02272459	0.31302679	-0.46666667	0.55927310
LDM	0.20801042	0.29568921	-0.45454545	0.62870323

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
ROW VARIABLE NAME=DPOKN				
BSDM	0.14030848	0.40093606	-0.60000000	0.63636364
ADM	0.13521688	0.27072687	-0.29090909	0.63636364
LDM	0.07576044	0.40933484	-0.61212121	0.76969697
ROW VARIABLE NAME=DPOR1				
BSDM	0.37288989	0.22197165	-0.04545455	0.69047619
ADM	0.15643371	0.34993010	-0.44242424	0.82857143
LDM	0.39105275	0.21897008	0.01818182	0.90476190
ROW VARIABLE NAME=DQR				
BSDM	0.43007844	0.28105645	-0.11818182	0.81818182
ADM	0.09767273	0.27711368	-0.40909091	0.48571429
LDM	0.42029455	0.29830193	-0.32121212	0.92857143
ROW VARIABLE NAME=DROI				
BSDM	0.18798486	0.34145229	-0.94285714	0.70000000
ADM	0.10811043	0.40003867	-0.71428571	0.67272727
LDM	0.16105330	0.30563566	-0.60000000	0.69090909
ROW VARIABLE NAME=DRT				
BSDM	0.19051059	0.26752952	-0.27272727	0.69696970
ADM	0.13731258	0.26997075	-0.48571429	0.56363636
LDM	0.14415584	0.32568296	-0.31818182	0.53939394
ROW VARIABLE NAME=DVKN				
BSDM	0.31875806	0.27350722	-0.21428571	0.80606061
ADM	0.21488489	0.35744815	-0.85714286	0.77142857
LDM	0.20613228	0.29681021	-0.28181818	0.83030303
ROW VARIABLE NAME=DVPKN				
BSDM	0.25470708	0.26393825	-0.30909091	0.69696970
ADM	0.21863958	0.34051744	-0.50000000	0.83636364
LDM	0.19948169	0.29328506	-0.36363636	0.68181818

Table 2 Averages of correlations time spanning one year

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
ROW VARIABLE NAME=DCR				
BSDM	0.42743089	0.36983113	-0.23333333	0.93333333
ADM	0.25915574	0.33347041	-0.27272727	0.65000000
LDM	0.44752970	0.32803272	-0.13333333	0.91214188
ROW VARIABLE NAME=DDE				
BSDM	0.33043302	0.32505625	-0.18787879	0.81167945
ADM	0.17822951	0.27483885	-0.38333333	0.68484848
LDM	0.38056870	0.37606898	-0.23636364	0.93333333
ROW VARIABLE NAME=DKPOT				
BSDM	0.17651515	0.39063454	-0.51666667	0.70909091
ADM	0.21144640	0.44115452	-0.73333333	0.81818182
LDM	0.18339381	0.39324953	-0.56666667	0.72121212
ROW VARIABLE NAME=DLVT				
BSDM	0.22243761	0.43423934	-0.55000000	0.90000000
ADM	0.25316877	0.43548229	-0.68333333	0.90000000
LDM	0.21077795	0.46553846	-0.61666667	0.86666667
ROW VARIABLE NAME=DMSKN				
BSDM	-0.03201089	0.44521071	-0.78181818	0.78333333
ADM	-0.10416042	0.43524187	-0.71428571	0.65000000
LDM	0.05802773	0.43952710	-0.64848485	0.75000000
ROW VARIABLE NAME=DMT				
BSDM	0.24811720	0.44982024	-0.66666667	0.83030303
ADM	0.29228419	0.46528641	-0.70000000	0.86666667
LDM	0.22057073	0.44346607	-0.75000000	0.79393939
ROW VARIABLE NAME=DOMAV				
BSDM	0.32281528	0.36514379	-0.35909242	0.79393939
ADM	0.22648548	0.35122715	-0.35909242	0.74545455
LDM	0.33792755	0.39065368	-0.34545455	0.98561076
ROW VARIABLE NAME=DOPOT				
BSDM	0.29962917	0.42774883	-0.61666667	0.90303030
ADM	0.30896836	0.46618542	-0.58333333	0.78333333
LDM	0.28336676	0.44965360	-0.70000000	0.91515152
ROW VARIABLE NAME=DOVKN				
BSDM	0.00662401	0.30561706	-0.47878788	0.60000000
ADM	0.03470843	0.37872152	-0.57575758	0.66666667
LDM	0.01463505	0.30308095	-0.54285714	0.80000000

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
ROW VARIABLE NAME=DPOKN				
BSDM	0.12113107	0.27618069	-0.46666667	0.45454545
ADM	0.09401004	0.32805501	-0.67477515	0.51666667
LDM	0.09888120	0.24928628	-0.41666657	0.53939394
ROW VARIABLE NAME=DPOR1				
BSDM	0.48644836	0.29754505	-0.09090909	0.90000000
ADM	0.29137038	0.30746210	-0.31428571	0.90000000
LDM	0.50220102	0.28384494	-0.06666667	0.94285714
ROW VARIABLE NAME=DQR				
BSDM	0.31237904	0.33307452	-0.40000000	0.81666667
ADM	0.15748981	0.23063279	-0.40000000	0.46666667
LDM	0.31903011	0.30078541	-0.16363636	0.73333333
ROW VARIABLE NAME=DROI				
BSDM	0.24537656	0.37803464	-0.53333333	0.72121212
ADM	0.23771645	0.38016559	-0.50000000	0.76666667
LDM	0.21810861	0.35050984	-0.63333333	0.71428571
ROW VARIABLE NAME=DRT				
BSDM	0.20329768	0.41997974	-0.53333333	0.71666667
ADM	0.23757162	0.43364009	-0.71666667	0.70909091
LDM	0.14802171	0.45774967	-0.73333333	0.79393939
ROW VARIABLE NAME=DVKN				
BSDM	0.18952922	0.37467711	-0.60000000	0.80000000
ADM	0.10386268	0.36784781	-0.60000000	0.70909091
LDM	0.14118125	0.36980421	-0.46666667	0.78333333
ROW VARIABLE NAME=DVPKN				
BSDM	0.27431636	0.46891366	-0.70000000	0.85000000
ADM	0.16576189	0.46253782	-0.70000000	0.83333333
LDM	0.29919777	0.40481396	-0.43333333	0.80000000

Table 3 Averages of correlations time spanning two years

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
ROW VARIABLE NAME=DCR				
BSDM	0.33350186	0.44767631	-0.80000000	0.93333333
ADM	0.29280538	0.51303843	-1.00000000	0.85000000
LDM	0.25191342	0.34287291	-0.43333333	0.86666667
ROW VARIABLE NAME=DDE				
BSDM	0.35096419	0.34834122	-0.23333333	0.90000000
ADM	0.22743015	0.43578227	-0.54761905	0.91666667
LDM	0.38823298	0.32949366	-0.23333333	1.00000000
ROW VARIABLE NAME=DKPOT				
BSDM	0.30169225	0.39807436	-0.80000000	0.95238095
ADM	0.24208973	0.39332430	-0.57142857	0.88095238
LDM	0.32900433	0.37793872	-0.60000000	0.90476190
ROW VARIABLE NAME=DLVT				
BSDM	0.20710350	0.40569325	-0.80000000	0.80952381
ADM	0.13760331	0.40238165	-1.00000000	0.69047619
LDM	0.27741047	0.45732296	-0.42857143	0.92857143
ROW VARIABLE NAME=DMSKN				
BSDM	0.00957059	0.36648580	-0.61904762	0.58333333
ADM	-0.04819544	0.43164616	-0.95000000	0.56666667
LDM	-0.11089175	0.34831870	-0.80000000	0.40000000
ROW VARIABLE NAME=DMT				
BSDM	0.23898072	0.35538764	-0.80000000	0.75000000
ADM	0.20602125	0.37100888	-0.54761905	0.73809524
LDM	0.28461236	0.29083621	-0.60000000	0.60000000
ROW VARIABLE NAME=DOMAV				
BSDM	0.34275244	0.42102534	-0.38333333	0.91666667
ADM	0.26108080	0.48452034	-0.56288434	0.93333333
LDM	0.32968293	0.40216710	-0.53333333	1.00000000
ROW VARIABLE NAME=DOPOT				
BSDM	0.21320346	0.41418821	-0.80000000	0.86666667
ADM	0.21674538	0.41113045	-0.69047619	0.85000000
LDM	0.25983865	0.37505378	-0.60000000	0.78333333
ROW VARIABLE NAME=DOVKN				
BSDM	0.00952567	0.41571278	-0.80952381	0.66666667
ADM	-0.06600469	0.43555770	-0.83333333	0.73809524
LDM	0.05420798	0.40296460	-0.85714286	0.59523810

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
ROW VARIABLE NAME=DPOKN				
BSDM	0.02538185	0.36318816	-1.00000000	0.59523810
ADM	-0.03962691	0.34194423	-0.80000000	0.40000000
LDM	-0.02909362	0.35708509	-0.80000000	0.53333333
ROW VARIABLE NAME=DPOR1				
BSDM	0.44573073	0.35885277	-0.36666667	0.90476190
ADM	0.25692644	0.33900449	-0.31666667	1.00000000
LDM	0.46127952	0.41013306	-0.48333333	0.90000000
ROW VARIABLE NAME=DQR				
BSDM	0.13612751	0.37547887	-0.45238095	0.69047619
ADM	0.05277450	0.33296910	-0.50000000	0.52380952
LDM	0.15062967	0.41534550	-0.60000000	0.80000000
ROW VARIABLE NAME=DROI				
BSDM	0.28862652	0.40914336	-0.80000000	0.92857143
ADM	0.22109406	0.41258618	-0.61904762	0.95238095
LDM	0.30745769	0.33311301	-0.60000000	0.78571429
ROW VARIABLE NAME=DRT				
BSDM	0.11519087	0.38431395	-0.80000000	0.71428571
ADM	0.10480126	0.35497876	-0.80000000	0.56666667
LDM	0.19620228	0.38125281	-0.36666667	0.97619048
ROW VARIABLE NAME=DVKN				
BSDM	0.05129870	0.33764656	-0.51666667	0.63333333
ADM	0.02062180	0.40378004	-0.81666667	0.55000000
LDM	-0.06259347	0.33066798	-1.00000000	0.40000000
ROW VARIABLE NAME=DVPKN				
BSDM	0.19885872	0.35779783	-1.00000000	0.61904762
ADM	0.13292011	0.37315845	-0.80000000	0.68333333
LDM	0.14576938	0.35057674	-0.80000000	0.60000000

Table 4 Averages of correlations time spanning three years

As expected, the correlations are higher for financial ratios calculated directly from the fractions of balance sheet. The correlations for ratios based partly on income flows seem to be lower instead.

It can also be seen from the minimum and maximum values of in the table that the correlations vary considerably across the firms. However for most ratios and firms the correlations differ significantly from zero. It sholud also be stated that the interpretation of the numerical value of the Spearman rank correlation coefficient is not easy. Spearman rank correlation was chosen in this study primarily because of the skewed distributions of the financial ratios in the data.

4.2 Decomposition measures spanning over several years

In this case the decomposition measures were computed by using intervals of two and three years. Changes in the values of ratios were defined respectively and the Spearman rank correlations were computed. The results in Tables 3 and 4 do not differ significantly from those results where the basic definition was used.

5 Decomposition measures as indicators of abnormal periods

In this section illustrative examples concerning the use of decomposition measures in monitoring financial statements are presented.

In the figure 2, decomposition measures for one particular company are presented graphically as functions of time. The time spanning is one year.

This graphical representation shows that during the period of 78 - 79 changes have occured mostly in the liabilities side of the balance sheet. In Figure 3 respective relative proportions of balance sheet are preseented graphically. It is easy to see the large change in short-term debt during the period.

Considerable changes in the asset side during the periods of 1970 - 1971 and 1973 - 1974 are also presented in Figure 2 by peaks in ADM (asset decomposition measure). In these periods also the ratios used in this study varied considerably. Percentage changes varied from 10 per cent to 300 per cent.

In Figure 4 a different spanning was used for another company. The measures were now detecting gradual changes in the same direction during three years periods. Interesting periods seem to be 73 - 76 in the liabilities side and 74 - 77 in the asset side. Inspection of Figure 5 confirms the observation.

6 Conclusions

It is important to notice again that the method presented in this paper gives no information about the quality of the change detected. Once high values of decomposition measures are observed more advanced measures are needed in order to evaluate the financial position of the firm.

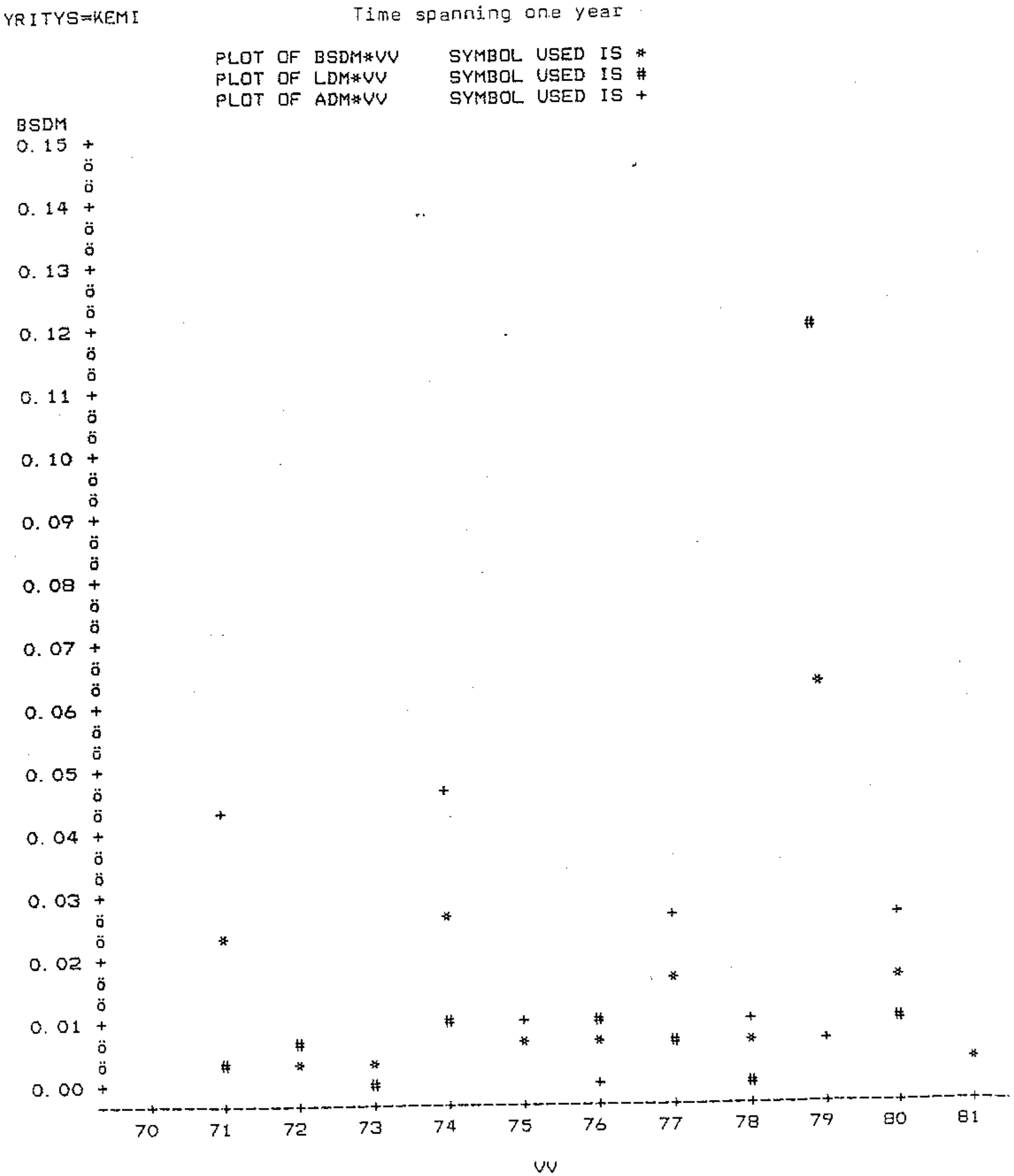
However, decomposition measures seem to be well suited for monitoring a large amount of financial statements at general level. One possible application is to use these measures as keys in computer aided search in large databases. Decomposition measures are not bounded to any specific structure of balance sheet (as e.g. in the one used in this study) and therefore they can be used as general measures of variability.

The problem is to decide an approriate treshold value for the measures. In the previous examples an arbitrary value of 0.10 was used to classify the value as "significant". These judgements should obviously rely on previous experience.

Figure 2

DECOMPOSITION MEASURES

Time spanning one year



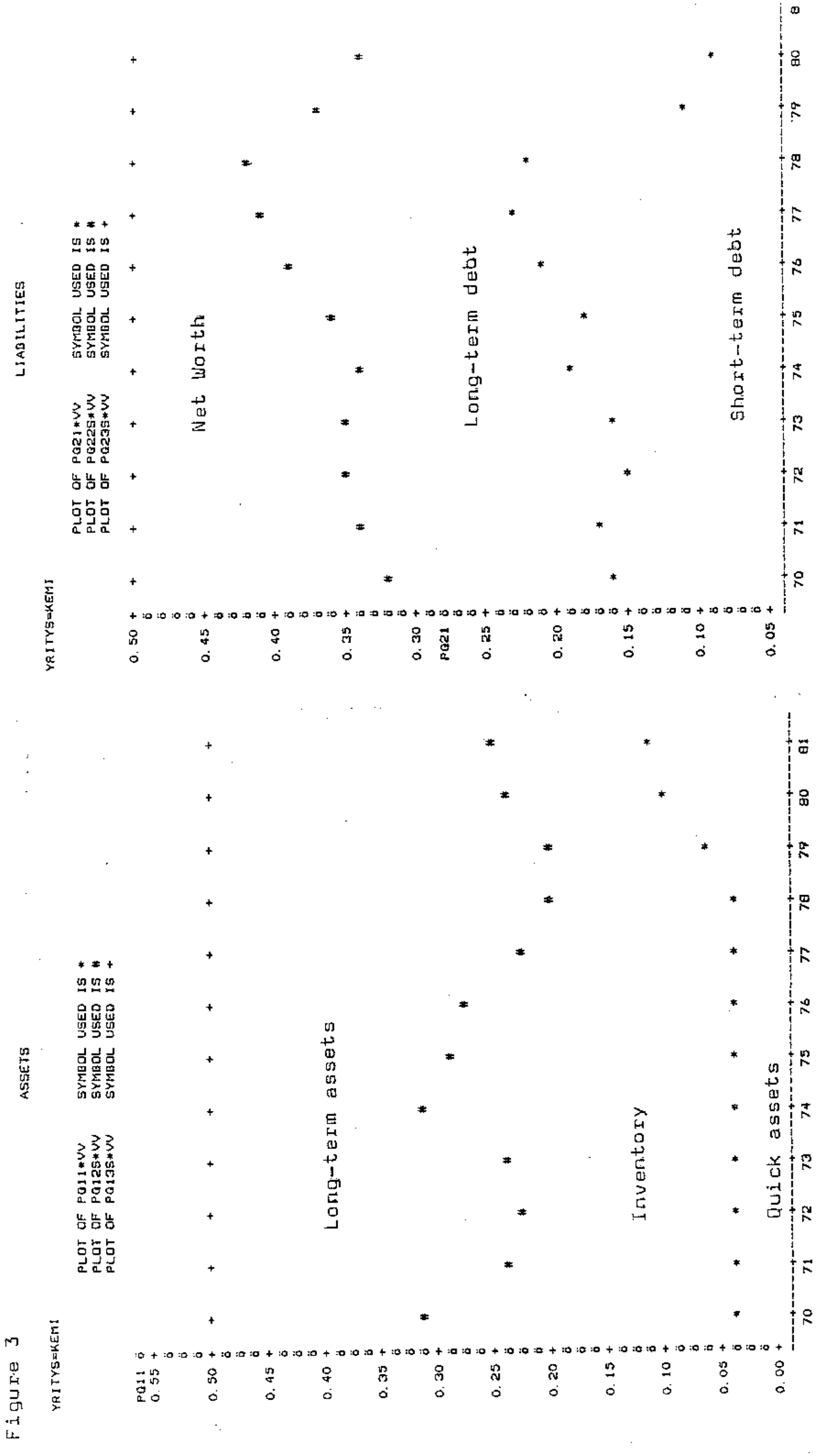
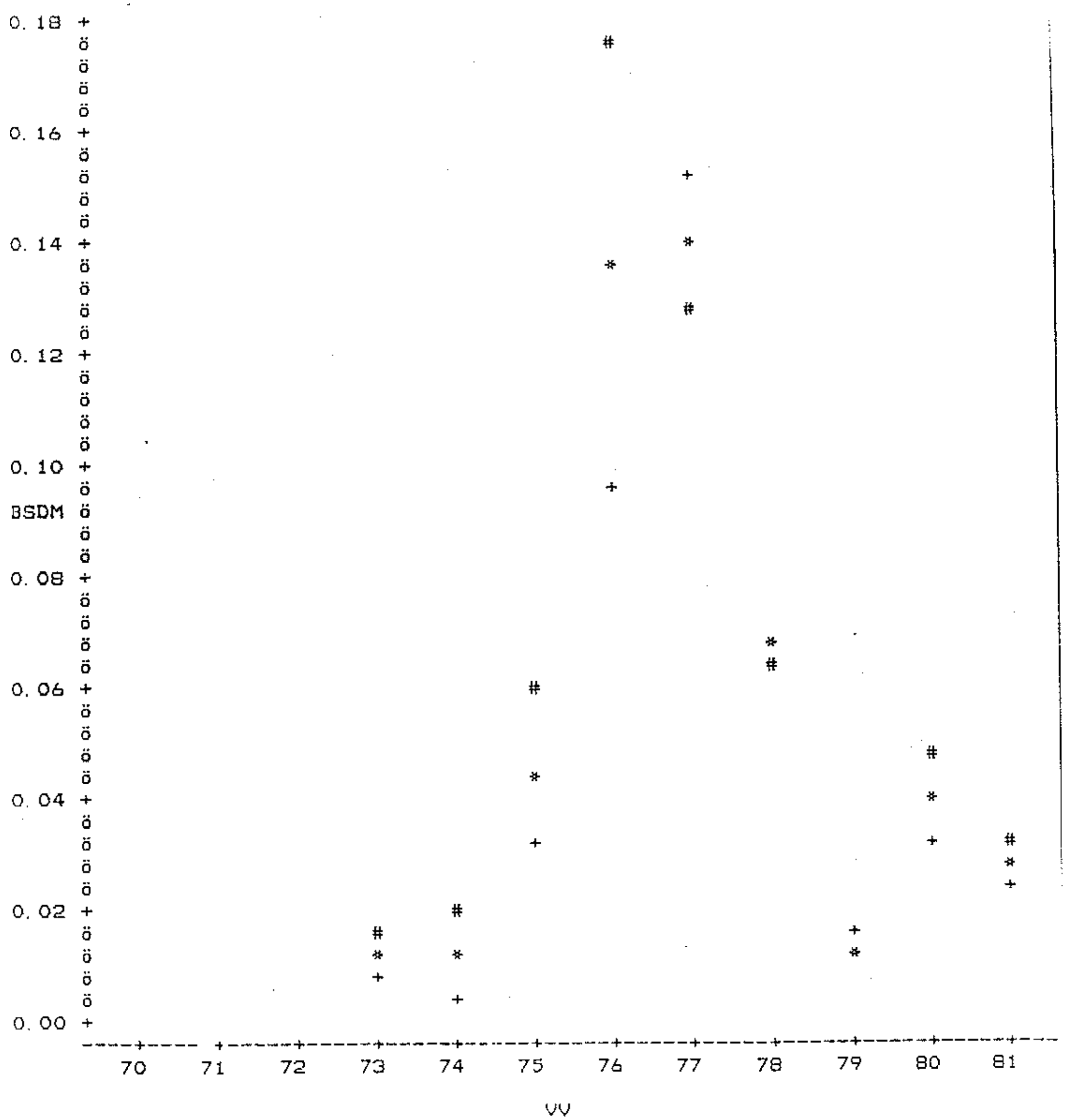


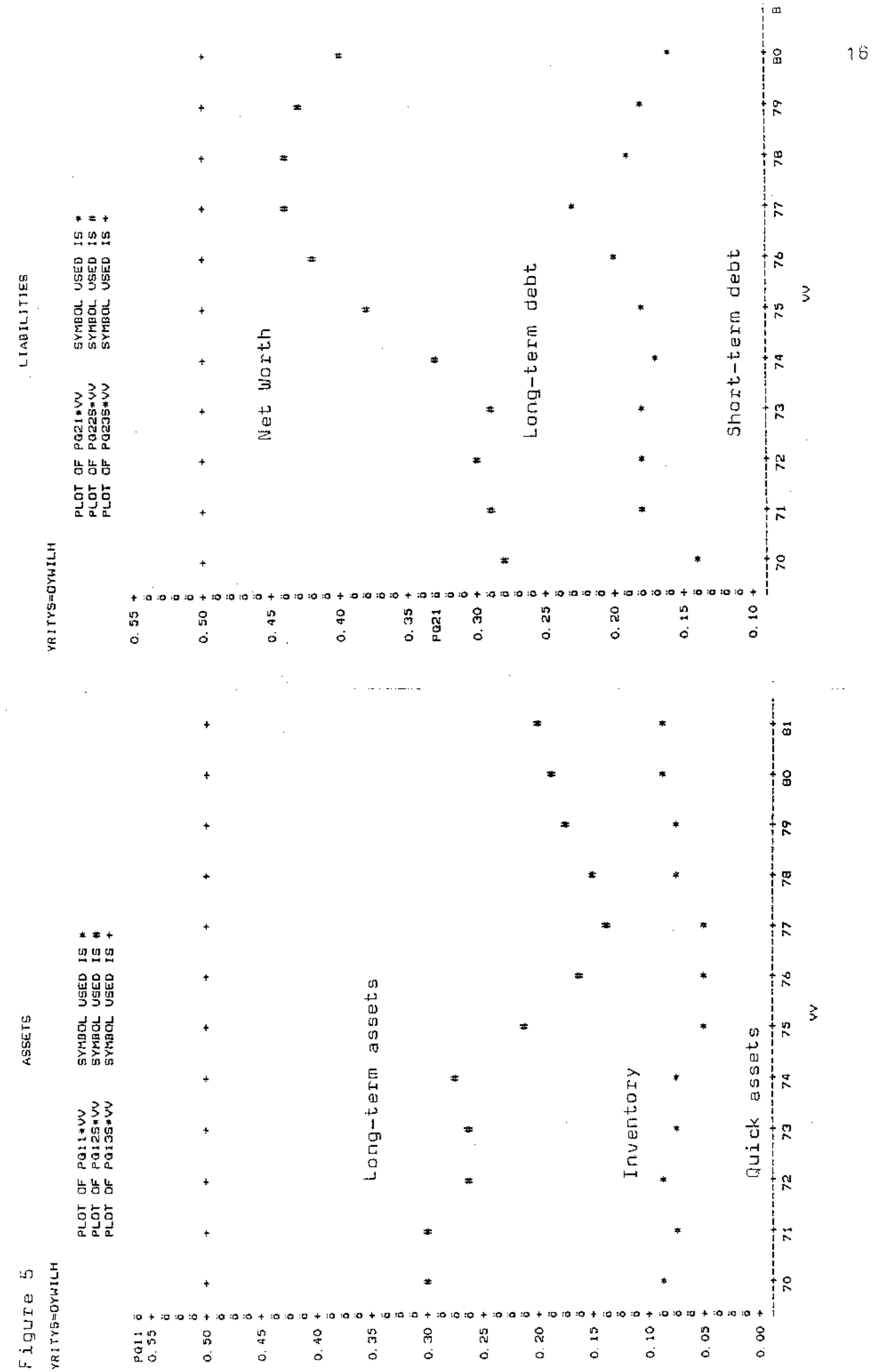
Figure 3

Figure 4 DECOMPOSITION MEASURES SPANNING 3 YEARS

'RITYS=OYWILH

PLOT OF BSDM*VV SYMBOL USED IS *
PLOT OF LDM*VV SYMBOL USED IS #
PLOT OF ADM*VV SYMBOL USED IS +





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