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THE GENERALIZED ASSOCIATION BETWEEN FINANCIAL STATEMENTS AND SECURITY CHARACTERISTICS

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Abstract — A strong relationship between the firm's financial ratios and its security characteristics is observed when canonical correlation analysis is applied, rather than attempts to measure the volatile relationships between the individual variables. It is seen from a sample of 32 firms for the period 1974–84 that the key ratios in the relationship differ over time. Furthermore, it is observed that accrual-based ratios are related more significantly than cash-based ratios to the security characteristics. Cash-based ratios are incrementally significant, however. To establish a relationship between the financial ratios and the security characteristics a limited number of temporally varying key ratios is sufficient. Finally, it is observed that in assessing security characteristics the expected returns and beta are sufficient. Higher moments have no incremental significance.
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Key words: Financial statement analysis, accrual basis, cash basis, market-based ratios, canonical correlations.

INTRODUCTION AND OVERVIEW

The financial statements of the business firm serve as the primary financial reporting mechanism of the firm, both internally and externally. Financial statements are the method by which management communicates financial information to decision makers such as owners, personnel, customers, suppliers, competitors, regulatory agencies and academics, all of whom have their own views and goals when they use the financial statements in their evaluations. Financial statement analysis is a prevalent method for processing the relevant data for the decision makers. Typically, the information is summarized in the form of financial ratios. On the stock market the investors use market-based indicators of the stock-price behaviour combined with the firms' accounting information.

Many studies have considered the association between a firm's financial ratios and its security characteristics as measured by market-based ratios. Studies by Ball and Brown (1969), Beaver *et al.* (1970), Gonedes (1973), Beaver and Manegold (1975), Bildersee (1975), Bowman (1979), Hill and Stone (1980), Barlev and Livnat (1986), and Ismail and Kim (1989) all focus on the association between a firm's accounting beta and its security market beta. Bowman (1979) provides a theoretical analysis of the relationship between the firm's systematic risk (security market beta) and the firm's accounting beta (and leverage), while Ismail and Kim (1989) present empirical evidence on the association. These results point to a relationship between a firm's risk related to the financial variables and security characteristics, which is the subject of this paper.

Beaver *et al.* (1970), Pettit and Westerfield (1972), O'Connor (1973), Rosenberg and McKibben (1973), Hochman (1983), Martikainen (1990a, 1990b), and Kim and Lipka (1991) seek to establish which single financial ratio, or cluster of financial ratios, best correlate with a

security's return and risk. This approach implicitly assume that the market's evaluation of a firm's performance and financial standing is based on an unvarying set of financial ratios. For example, Martikainen (1990a, 1990b) uses profitability, financial leverage, operating leverage, and growth to explain in turn the firm's security price, return, and risk.

We shall extend these results by taking a more generalized approach to the question of the association. Our first question is whether there is a general correlation between financial ratios and security characteristics. To investigate this, we use canonical correlation analysis on a cross-section of (accrual-based and cash-based) financial ratios and security information concerning 32 publicly traded Finnish companies for the period 1974–84. Our results confirm that security return and risk are strongly associated with financial ratios, but that the set of best predicting financial ratios is not constant.

Wilson (1986, 1987), Bowen *et al.* (1987), Blann and Balachandran (1988), Kinnunen (1988), Bernard and Stober (1989), Ismail and Kim (1989), Ou and Penman (1989), Sudarsanam and Fortune (1989), Livnat and Zarowin (1990), and Niskanen (1990), among others, have investigated whether cash-based financial ratios behave differently from accrual-based financial ratios, and whether they contain more relevant information for security investment decisions than the accrual-based figures. The general contention in these studies has been that cash flows carry significant incremental information for the decision maker. For example, Ismail and Kim (1989) came to the conclusion that cash-flow data has the potential to supply additional information on a firm's risk beyond that available from earnings. These results give rise to our second question: whether the cash-based financial ratios or the accrual-based financial ratios have a stronger relation with security characteristics. Our results do not corroborate the view that the cash-flow information would have more relevance than the accrual-based figures (rather, vice versa).

A consequent question arising from the above results and earlier research is whether the cash-based information is still incrementally significant for a relationship between financial ratios and security characteristics. Our empirical results show that the cash flows impart marginal incremental information for security evaluation.

It is commonly believed that investors use only a few key factors in their evaluation of a firm's performance and financial standing. Thus we also investigate whether the generalized association between the financial ratios and the security characteristics still holds for a reduced set of accrual-based financial ratios. Our empirical results conform to the view that a few key factors are sufficient. The adjusted strength of the observed correlation between the reduced set and the security characteristics in on par with the non-reduced set of financial ratios.

Pinches *et al.* (1973), Pinches *et al.* (1975), Laurent (1979), Johnson (1979), Aho (1980), Chen and Shimerda (1981), Pohlman and Hollinger (1981), Cowen and Hoffer (1982), Yli-Olli and Virtanen (1985, 1990), Ezzamel *et al.* (1987), Salmi *et al.* (1990), Kanto and Martikainen (1991), and Luoma and Ruuhela (1991) represent a strong tradition of research in financial statement analysis which seek to reduce a (large) number of financial ratios to a smaller number of mutually exclusive categories covering the various aspects of the firm's activities. These studies have typically used factor analysis methods. The implication for our study is that the information content of the financial ratios is portrayed by a limited set of key ratios, and we shall consequently look into the correlation between this set and the security characteristics.

Fama and MacBeth (1973, 1974), and Roll (1977) indicate that, in the Security Market Line (SML) form of the Capital Asset Pricing Model (CAPM), two parameters of returns, i.e. mean and beta-risk, are the sufficient statistics for defining the properties of a security. This means that according to CAPM the higher moments of the returns may not be relevant to the decision maker. Thus, our fourth question is whether the observed expected returns and betas are adequate, or

whether the empirical relation between financial ratios and security characteristics is strengthened by the inclusion of the higher moments of security returns. Our empirical results indicate that inclusion of the higher moments does not strengthen the empirical association and thus corroborate the SML form of CAPM.

SPECIFIC RESEARCH QUESTIONS

We pose four sets of research questions concerning the association between financial ratios and market-based ratios. Our first pair of questions relates to the potential association and its stability between a firm's financial characteristics as expressed by its financial ratios (accounting-based information) and its securities' characteristics (market-based information). If an association is observed, this corroborates a view that financial ratio analysis can be a useful part of security analysis.

As discussed in the introduction, previous studies have sought to identify stable relationships between security characteristics and particular financial ratios, or financial ratio factors. However, looking at particular financial ratios is a limiting precondition, and we pose the first question in more general terms, and use a more generic statistical methodology (canonical correlation analysis). Thus, we get the first pair of research questions:

(1a) Is there a statistically significant canonical correlation between the firms' accrual-based and cash-based financial ratios, and the security characteristics?

(1b) If such a correlation exists, is it stable over time?

The relative usefulness of alternative accounting information bases has been much discussed. In particular, much interest has been focused on the question of whether accrual-based or cash-based accounting produces more relevant information for security analysis. Two different views on cash-based figures should be noted here. In the theory of finance (capital investments more particularly) the focus of interest is on the value of the firm (and consequently the security behaviour), which is considered to be the present value of all the firm's future cash flows. On the other hand, the more pragmatic financial accounting has a different focus of interest. This accounting-practice doctrine sees cash-flow and funds-flow information primarily as supplemental information to historical accrual-based financial statements in annual disclosure. Because of this practical aspect, the observable cash-flow information has this supplemental nature in financial ratio analysis, rather than being a self-contained alternative information set. The difference discussed relates to accounting practices. Furthermore, Ohlson (1990, p. 674) points out that theoretical links between accounting and valuation attributes are not taken up in the literature, but that there is nothing intrinsically wrong with not specifying such an explicit link. The information value of the various set of variables thus remains an empirical question. To consider this potential difference empirically, we pose our second set of research questions:

(2a) If a correlation in 1a is observed, do the accrual-based and cash-based ratios, when taken separately, have a correlation with the security characteristics?

(2b) If both the correlations exist, which of the two, the cash-based or the accrual-based figures correlate more strongly with the security characteristics?

(2c) If there is a difference in 2b, does the less significant set (cash-based/accrual-based) still give some incremental correlation information?

It is typical of the human decision making process that the decision maker seeks to reduce the influx of information into a few key elements or figures. This tendency to keep information in manageable proportions and to concentrate on what is deemed essential, gives rise to our next research question for testing the view that investors use only a few key ratios:

(3) Can a reduced set of financial ratios have essentially the same correlation with security characteristics as a non-reduced one?

Finally, we can look at the question of whether the standard CAPM is a sufficient description of the market return. If the standard CAPM is the best description of the general equilibrium, then the higher moments should have no effect on the market return. In accordance with this view the mean and beta of security returns would be sufficient surrogates of security characteristics. Thus we state our fourth research question:

(4) Is the correlation between the financial ratios and the security characteristics strengthened by the inclusion of variance, skewness, and kurtosis of security returns?

Figure 1 illustrates the potential associations. It can be pointed out that research questions 1, 2 and 3 are empirical issues. They are concerned with the quality/usefulness of financial ratios. Research question 4 involves a theoretical issue concerning security characteristics.

DATA AND METHODOLOGY DESCRIPTION

Our full set of the accrual-based financial ratios is the same as that used in Foster (1978, p. 60), which has been used in many studies. The accrual-based ratios are listed in the Appendix (variables x_1–x_{12}). The definitions for calculating these basic ratios are given in Yli-Olli (1983, pp. 62–65); for a discussion, see also Yli-Olli and Virtanen (1985, pp. 11–13). The full set of the

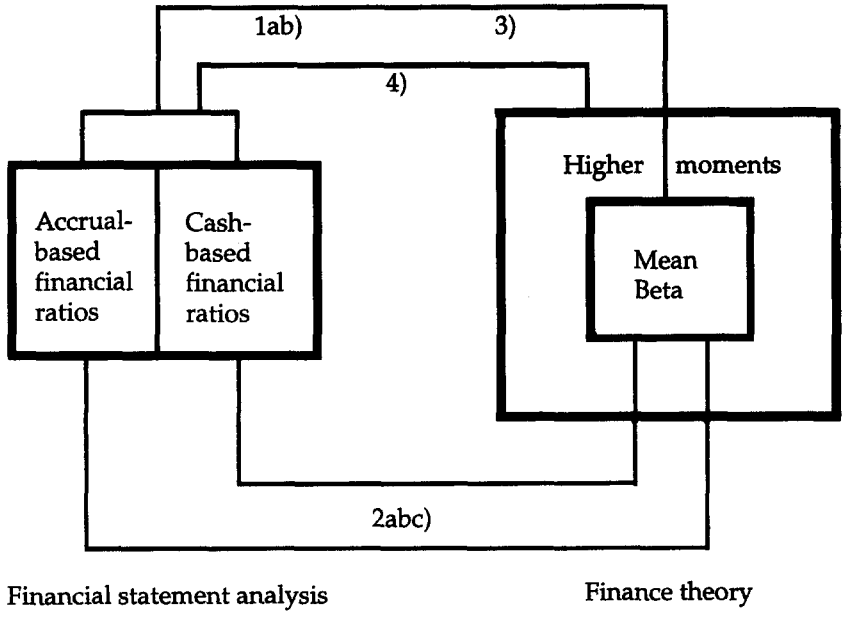

Fig. 1. Illustration of the research questions.

cash-based financial ratios follows Gombola and Ketz (1983). The cash-based ratios are listed in the Appendix (variables x_{13}–x_{20}).

The data used in this study consist of all the firms that have had their ordinary shares listed in the Helsinki Stock Exchange. The ratios were obtained for cross-sections of 32 publicly traded Finnish companies for 1974–84. [See Salmi *et al.* (1990, Table G) for a list of the firms included in the analysis.] Financial firms are excluded in this study. The ratios have been taken from the TILPANA data base constructed at the University of Vaasa. The financial statement analyses carried out in this study are based on published financial statement figures, adjusted according to the recommendations of the Finnish Committee for Corporate Analysis (Yritystutkimusneu-vottelukunta, 1990).

The period chosen was 1974–84, for compatibility with earlier, related research projects. Yli-Olli and Virtanen (1990) looked into the classification and stability of financial ratios for the same period, but did not include market-based financial ratios. Salmi *et al.* (1990) applied factorization of financial ratios on accrual-based, cash-based and market-based ratios. Both these research projects used the period 1974–84. The 1974–84 period was a stable one in the Finnish economy, whereas during 1985–88 the economy overheated with the result that share prices were excessively high. From 1989 there was an exceptionally steep, long decline in the Finnish stock market and in the Finnish economy.

The security characteristics (x_{21}–x_{25}) listed in the Appendix, i.e. the beta and return, and the variance, skewness and kurtosis of return series, were calculated from the weekly stock returns for the same group of 32 companies. The annual values are thus based on 52 observations each.

To obtain the values of the variables (both financial ratios and security characteristics) for our study period (1974–84) and the subperiods (1974–78, 1979–84), we applied simple arithmetic averages of the annual data.

This grouping (averaging) of ratios was needed to make the three-dimensional data (the variables, cross-sectional variation, intertemporal variation) two-dimensional. This means, of course, that there is some loss of information, but the averaging must be done for the correlation analysis. Contrary to regression analysis, correlation analysis (including the generalized canonical correlations) does not have any dummy variable or related technique for handling this type of interdependencies in the data. In addition, the annual fluctuations of the ratios would be so high that any pattern of correlation would be hidden by the two-dimensional (years, firms) residual variation. The annual variation was therefore averaged out before the standard analysis. The method of subdividing the basic period into two subperiods was used to study the stability over time of the correlation pattern obtained.

The individual asset returns were collected from a data base originally introduced by Berglund *et al.* (1983). The price indices used for calculating the returns were the closing values for each Wednesday. The prices were corrected for splits, new issues etc. assuming that dividends were reinvested with zero transaction costs. The returns for each week were calculated as first differences of the natural logarithms of these price indices. The general index in use (when calculating the betas) was the value-weighted market index taken from the same data base. The annual beta coefficients were calculated using Sharpe's market model with weekly returns.

For studying the association between the two sets of variables, i.e. financial ratios and security characteristics, we applied canonical correlation analysis. See for example Green (1978, pp. 260–289) for the statistical foundations of the canonical correlation analysis, and Fornell and Larcker (1980) and Pohlman and Hollinger (1981) for its applications in accounting research.

Canonical correlation analysis is a more general case of the usual multiple regression analysis. In multiple regression the aim is to find a linear combination of the independent (or predictor) variables such that the composite has the maximum correlation with the dependent (or

criterion) variable. In canonical correlation the interest centres on the linear association between one battery of variables, the predictor variables $x_1, x_2,...,x_p$, and another battery of variables, the criterion variables $y_1,y_2,...,y_q$.

The pairwise correlations within and between the x_i and the y_j variable sets can be presented as matrix

$$R = \begin{pmatrix} R_{yy} & R_{yx} \\ R_{xy} & R_{xx} \end{pmatrix} \tag{1}$$

The x_i and y_j variables can be assumed to have been routinely standardized to a zero mean and a unit standard deviation.

The objective in canonical correlation analysis is to find a linear composite of the x_i variables, $i = 1,2...,p$, and a (different) linear composite of the y_j-variables, $j = 1,2,...,q$, such that when this pair of derived variables (linear composites) is correlated, the resulting bivariate correlation is the highest attainable. The two linear composites are

$$v = \sum_{i=1}^{p} a_i x_i \tag{2}$$

and

$$w = \sum_{j=1}^{q} b_j y_j \tag{3}$$

where the canonical coefficients a_i and b_j are adjusted to make the v and w variables standardized as well. To solve the canonical correlation the ordinary bivariate correlation between the linear composites v and w

$$R_C = \frac{\sum_{k=1}^{m} v_k w_k}{m-1} \tag{4}$$

is maximized. In Formula (4) m is the number of observations, and v_k and w_k are the observed values for the v and w variables.

Having done this, it is (generally) possible to find a second pair of linear composites, chosen to be uncorrelated with the first pair, such that the correlation between this second pair of derived variables is, conditionally for the first pair, maximal. In general, with p predictors and q criteria we can obtain $r = \min(p,q)$ different pairs of linear composites. The correlations between successive pairs will, in general, decline in size.

In this study the predictor variables x of the model are the accrual-based and the cash-flow-based financial ratios x_1–x_{20}. The criterion variables y are the market-based characteristics x_{21}–x_{25}.

EMPIRICAL RESULTS AND INTERPRETATION

The Appendix provides a summary of the basic statistics of the variables for the entire period 1974–84, and the subperiods 1974–78 and 1979–84.

First the association between all the financial ratios (the twelve averaged accrual-based ratios

Table 1(a) Canonical correlation analysis: return and beta vs. all financial ratios, 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate F	p-value
1	0.925	0.871	0.0258	0.0328	2.25	0.027*
2	0.878	0.816	0.0411	0.2288	1.95	0.128

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Standardized canonical coefficients for the criterion variables			
	w_1	w_2	
x_{21}	0.597	–0.872	security's beta
x_{22}	1.018	0.282	return on the security

Standardized canonical coefficients for the predictor variables			
	v_1	v_2	
x_1	–0.944	0.820	CR current ratio
x_2	0.479	–1.001	QR quick ratio
x_3	–1.015	1.523	DI defensive interval measure
x_4	0.840	–1.620	DE debt to equity
x_5	–0.589	1.603	LTDE long-term debt to equity
x_6	–0.163	–0.672	TIE times interest earned
x_7	2.231	–0.147	ES earnings to sales
x_8	–0.472	–0.243	ROA return on assets
x_9	–0.482	–0.223	ROE return on equity
x_{10}	0.448	0.813	TAT total assets turnover
x_{11}	–0.031	0.897	IT inventory turnover
x_{12}	–0.530	0.235	ART accounts receivable turnover
x_{13}	1.474	–0.974	cash/current debt
x_{14}	0.226	–1.072	cash/sales
x_{15}	0.282	0.422	cash/total assets
x_{16}	–1.706	0.997	cash/total debt
x_{17}	0.343	1.131	cash flow/equity
x_{18}	–1.614	–0.148	cash flow/sales
x_{19}	–0.627	–2.455	cash flow/total assets
x_{20}	1.423	1.943	cash flow/total debt

and the eight averaged cash-based ratios) and the CAPM security characteristics (the average return and beta) was studied for the entire 1974–84 period. The relevant empirical results of the canonical correlation analysis are presented in condensed form in Table 1(a). The first canonical correlation between the financial ratios and security characteristics is 0.925, and the correlation is significant ($p = 0.027$) at the 5% risk level. Thus the answer to our first question (1a) is that there is a significant correlation between financial ratios and security characteristics.

Our next question (1b) concerned the stability of the correlation. The results in Table 1(b) and Table 1(c) for the subperiods 1974–78 and 1979–84 respectively, give reasonable support for

Table 1(b) Canonical correlation analysis: return and beta vs. all financial ratios, 1974–78

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate F	p-value
1	0.941	0.902	0.0205	0.0458	1.83	0.073****
2	0.773	0.632	0.0720	0.4009	0.86	0.624

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Standardized canonical coefficients for the criterion variables			
	w_1	w_2	
x_{21}	–0.058	1.123	security's beta
x_{22}	0.972	0.565	return on the security

Standardized canonical coefficients for the predictor variables			
	v_1	v_2	
x_1	0.220	–0.829	CR current ratio
x_2	–0.781	0.270	QR quick ratio
x_3	1.047	–0.140	DI defensive interval measure
x_4	–1.184	–0.785	DE debt to equity
x_5	1.405	1.192	LTDE long-term debt to equity
x_6	0.298	0.726	TIE times interest earned
x_7	1.723	2.026	ES earnings to sales
x_8	–0.827	–0.767	ROA return on assets
x_9	–1.123	–1.300	ROE return on equity
x_{10}	1.247	0.907	TAT total assets turnover
x_{11}	0.173	–1.302	IT inventory turnover
x_{12}	0.148	0.165	ART accounts receivable turnover
x_{13}	–0.342	–0.064	cash/current debt
x_{14}	–0.520	0.539	cash/sales
x_{15}	–0.284	–0.164	cash/total assets
x_{16}	0.929	–0.148	cash/total debt
x_{17}	1.295	0.121	cash flow/equity
x_{18}	–0.950	0.985	cash flow/sales
x_{19}	–0.957	–0.616	cash flow/total assets
x_{20}	1.136	–1.199	cash flow/total debt

general stability. But although numerically high (R_C = 0.941), the correlation is not strictly significant (p = 0.073) at the 5% risk level for the 1974–78 period.

From a comparison of the standardized canonical coefficients for the individual variables, a very interesting observation emerges. Although there is a general association between the financial ratios and security characteristics, the individually significant variables are not stable. In layman's terms this means that although it can be stated that financial ratio analysis is important for security analysis, a mechanistic analysis involving a nonvarying set of predetermined variables cannot be suggested. This volatility of the key ratios is also in line with the usual view in the literature that the last factors resulting from factoring financial ratios fluctuate widely from one study to another.

Table 1(c) Canonical correlation analysis: return and beta vs. all financial ratios, 1979–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate F	p-value
1	0.939	0.899	0.0209	0.0329	2.25	0.027*
2	0.846	0.759	0.0508	0.2829	1.46	0.261

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Standardized canonical coefficients for the criterion variables			
	w_1	w_2	
x_{21}	0.986	–0.173	security's beta
x_{22}	0.112	0.995	return on the security

Standardized canonical coefficients for the predictor variables			
	v_1	v_2	
x_1	–1.727	0.372	CR current ratio
x_2	1.644	–0.869	QR quick ratio
x_3	–2.094	1.610	DI defensive interval measure
x_4	3.806	–1.412	DE debt to equity
x_5	–3.613	1.309	LTDE long-term debt to equity
x_6	0.291	1.865	TIE times interest earned
x_7	2.243	–1.571	ES earnings to sales
x_8	–0.803	–0.042	ROA return on assets
x_9	–0.423	0.784	ROE return on equity
x_{10}	–0.272	0.411	TAT total assets turnover
x_{11}	–0.656	–0.462	IT inventory turnover
x_{12}	–0.697	–0.075	ART accounts receivable turnover
x_{13}	3.357	–0.476	cash/current debt
x_{14}	0.274	0.046	cash/sales
x_{15}	0.846	–2.765	cash/total assets
x_{16}	–3.502	3.119	cash/total debt
x_{17}	–0.813	–0.547	cash flow/equity
x_{18}	–0.914	0.784	cash flow/sales
x_{19}	1.374	5.381	cash flow/total assets
x_{20}	–0.564	–5.770	cash flow/total debt

Note that observing a strong association between financial ratios and security characteristics is not tantamount to claiming that abnormal returns can be earned by applying an analysis of financial ratios. This is not a CAR (cumulative abnormal returns) study.

Our second set of questions [2(a,b,c)] concerned the relevance of the accrual-based versus cash-based financial ratios in relation to security characteristics. From Table 2(a) and Table 2(b) it can be seen that both financial ratio sets are significantly correlated with security characteristics. The first canonical correlation for the accrual-based data is 0.867 ($p = 0.002$). The strength of the cash-based correlation 0.686 is clearly lower ($p = 0.047$). Note that this does not, per se, indicate that cash-flow information is less relevant for security analysis than accrual-based financial ratios. It does indicate,

Table 2(a) Canonical correlation analysis: return and beta vs. accrual-based financial ratios, 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate *F*	*p*-value
1	0.867	0.808	0.0446	0.1121	2.98	0.002**
2	0.741	0.661	0.0809	0.4504		0.074***

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Table 2(b) Canonical correlation analysis: return and beta vs. cash-based financial ratios, 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate *F*	*p*-value
1	0.686	0.559	0.0949	0.3501	1.89	0.047*
2	0.581	0.526	0.1189	0.6620	1.67	0.164

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

however, that the cash-based financial ratios suggested in the standard literature are much more narrowly defined than the accrual-based financial ratios. The sets of accrual-based financial ratios are much more varied and extensive than the cash-based ratios. One clear conclusion is that the traditional definitions of cash-based financial ratios need a serious revaluation. On the other hand the results in Table 1a and Table 2a-A show that including the cash-based information increases the canonical correlation from 0.867 to 0.925. This indicates that the cash-based figures have some incremental informational value for security analysis (Question 2c).

Our third question (3) concerned whether a limited set of key financial ratios is sufficient for security analysis. Table 3(a) gives the results for a reduced set of accrual-based ratios: quick ratio, debt to equity, return on equity, total assets turnover, and defensive interval measure. The selection of these five ratios was based on the classifications in Foster (1978), Lev (1974), Yli-Olli and Virtanen (1985), Salmi *et al.* (1990), and our own deliberations. The reduced set of financial ratios represents the following categories: Liquidity, Solvency, Profitability, Turnover, and Dynamic Liquidity [see Yli-Olli and Virtanen (1985) for the inclusion of the defensive interval measure to represent dynamic liquidity]. The correlation with security characteristics remains strong ($R_C = 0.803$) and highly significant ($p < 0.001$) for the reduced set of accrual-based financial ratios. Also the second canonical correlation is significant ($R_C = 0.598$, $p = 0.018$). This can be interpreted as an indicator of a potential two-dimensionality in the overall association between the firms' financial ratios and their security characteristics.

Likewise, the cash-based financial ratios from Gombola and Ketz (1983) were reduced to cash/sales and cash/flow equity, since these two can best be expected to be independent by definition. This reduction does not retain a significant association between cash-based financial ratios and security characteristics, as can be seen from Table 3(b) ($R_C = 0.412$, $p = 0.126$). This need not be indicative of a low level of usefulness of cash-based information. On the contrary it may be indicative of the fact that the cash-based financial ratios have previously been inadequately defined in the literature. A task for further research could be to look more fully into this aspect.

Table 3(a) Canonical correlation analysis: return and beta vs. reduced set of accrual-based financial ratios, 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate *F*	*p*-value
1	0.803	0.765	0.0638	0.2279	5.47	0.000***
2	0.598	0.568	0.1152	0.6417	3.62	0.018*

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Table 3(b) Canonical correlation analysis: return and beta vs. reduced set of cash-based financial ratios, period 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate *F*	*p*-value
1	0.412	0.320	0.1490	0.7769	1.88	0.126
2	0.253		0.1681	0.9359	1.98	0.170

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Our last question (4) was concerned to discover whether the inclusion of unsystematic risk (variance), and the higher moments (skewness and kurtosis) of the returns of individual securities, strengthens the empirical association between the financial ratios and security characteristics. This is an interesting question because the standard CAPM assumes normality of the returns (and thus no need for the higher moments), and also assumes that all relevant riskiness is reflected in the beta (systematic risk). On the basis of the results of testing the previous hypotheses we evaluate this association, using the reduced set of accrual-based financial ratios. The results in Table 4(a) and in Table 4(b) indicate that neither the variance nor the higher moments have any incremental influence on the strength of the canonical correlation coefficients. The insignificance of the higher moments has interesting implications on the empirical relevance of the CAPM. This corroborates that the standard CAPM is a sufficient description of the market returns, at least for the period under study and for the Finnish market.

Table 4(a) Canonical correlation analysis: return, beta and variance vs. reduced set of accrual-based financial ratios, 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate *F*	*p*-value
1	0.809	0.766	0.0619	0.2122	3.34	0.000***
2	0.610	0.564	0.1125	0.6150	1.71	0.117
3	0.137	–0.081	0.1762	0.9812	0.16	0.918

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Table 4(b) Canonical correlation analysis: return, beta, variance, skewness and kurtosis vs. reduced set of accrual-based financial ratios, 1974–84

Canonical correlations and their statistical significance						
Canonical variable	Canonical correlation	Adjusted canonical correlation	Approximate standard error	Likelihood ratio	Approximate *F*	*p*-value
1	0.816	0.758	0.0600	0.1727	2.01	0.010**
2	0.659	0.596	0.1015	0.5166	1.06	0.399
3	0.222	–0.237	0.1707	0.9142	0.24	0.986
4	0.164	–	0.1747	0.9615	0.24	0.909
5	0.108	–	0.1774	0.9882	0.30	0.582

*Statistically significant at the 0.050 level; **Statistically significant at the 0.010 level; ***Statistically significant at the 0.001 level; ****Statistically significant at the 0.100 level.

Also, note that our study includes only the pure skewness and kurtosis and not the coskewness or cokurtosis of the security's rate of returns with market rate of returns as proposed by Kraus and Litzenberger (1976) and Stephens and Proffitt (1991). Thus, we cannot draw any conclusions about whether coskewness and cokurtosis will have any significant association.

SUMMARY

Our results corroborate the view that, for an investor, a select set of accrual-based financial ratios contains essential information for security assessment, and that there is considerable redundancy in the financial ratios. This is in line with the observation that beyond five key ratios, the results of studies categorizing financial ratios have yielded no consistent patterns, but have varied from study to study. Our results also corroborate that a simple mechanistic analysis is not sufficient for investment decisions, since the weights of the key ratios vary significantly over time.

Our results cast doubt on the method ordinarily used for defining cash-based financial ratios in the restricted manner exemplified by Gombola and Ketz (1983). It remains a task for further research to see whether a definition of cash-based financial ratios such that they become true alternative counterparts of accrual-based figures, would add useful incremental information for security analysis.

Our results also show that measuring security characteristics with returns and beta coefficients is sufficient, in the sense that the unsystematic risk and the higher moments (skewness and kurtosis) of the returns of individual securities have no significant incremental information value for observing relationships between financial statement variables and security characteristics. The empirical results are thus in agreement with the CAPM.

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REFERENCES

Aho, T. (1980) Empirical classification of financial ratios. In *Management Science in Finland 1980 Proceedings*, ed. C. Carlsson, pp. 413–422. FORS, Turku.

Ball, R. and Brown P. (1969) Portfolio theory and accounting. *Journal of Accounting Research* **7**, 300–323.

Barlev, B. and Livnat, J. (1986) The statement of financial position: its relationship with security prices. *Journal of Business Finance and Accounting* **13**, 223–238.

Beaver, W. H., Kettler, P. and Scholes, M. (1970) The association between market-determined and accounting-determined risk measures. *The Accounting Review* **45**, 654–682.

Beaver, W. H. and Manegold, J. (1975) The association between market-determined and accounting-determined measures of systematic risk: some further evidence. *Journal of Financial and Quantitative Analysis* **10**, 231–284.

Berglund, T., Wahlroos, B. and Grandell, L. (1983) KOP:s och UNITAS generalindex för Helsingfors fondbörs i ljuset av ett nytt värdevägt index (in Swedish). *The Finnish Journal of Business Economics* **32**, 30–41.

Bernard, V. L. and Stober, T. L. (1989) The nature and amount of information in cash flows and accruals. *The Accounting Review* **64**, 624–652.

Bildersee, J. S. (1975) The association between a market-determined measure of risk and alternative measures of risk. *The Accounting Review* **50**, 81–98.

Blann, J. and Balachandran, B. V. (1988) An empirical test of the statistical association of market risk and financial accounting allocation. *Journal of Business Finance and Accounting* **15**, 101–113.

Bowen, R. M., Burgstahler, D. and Daley, L. A. (1987) The incremental information content of accrual versus cash flows. *The Accounting Review* **62**, 723–747.

Bowman, R. G. (1979) The theoretical relation between systematic risk and financial (accounting) variables. *The Journal of Finance* **34**, 617–630.

Chen, K. H. and Shimerda, T. A. (1981) An empirical analysis of useful financial ratios. *Financial Management* **10**, 51–60.

Cowen, S. S. and Hoffer, J. A. (1982) Usefulness of financial ratios in a single industry. *Journal of Business Research* **10**, 103–118.

Ezzamel, M., Brodie, J. and Mar-Molinero, C. (1987) Financial patterns of UK manufacturing companies. *Journal of Business Finance and Accounting* **14**, 519–536.

Fama, E. F. and MacBeth, J. D. (1973) Risk, return, and equilibrium: empirical tests. *Journal of Political Economy* **81**, 607–636.

Fama, E. F. and MacBeth, J. D. (1974) Tests of the multiperiod two-parameter model. *Journal of Financial Economics* **1**, 43–66.

Fornell, C. and Larcker, D. F. (1980) The use of canonical correlation analysis in accounting research. *Journal of Business Finance and Accounting* **7**, 455–473.

Foster, G. (1978) *Financial Statement Analysis.* Prentice Hall, Inc., Englewood Cliffs, New Jersey.

Gombola, M. J. and Ketz, J. E. (1983) A note on cash flow and classification patterns of financial ratios. *The Accounting Review* **58**, 105–114.

Gonedes, N. J. (1973) Evidence on the information content of accounting numbers: accounting-based and market-based estimates of systematic risk. *Journal of Financial and Quantitative Analysis* **8**, 407–443.

Green, P. E. (1978) *Analyzing Multivariate Data.* The Dryden Press, Hinsdale, Illinois.

Hill, N. C. and Stone, B. K. (1980) Accounting betas, systematic operating risk, and financial leverage: a risk-composition approach to the determinants of systematic risk. *Journal of Financial and Quantitative Analysis* **15**, 595–637.

Hochman, S. (1983) The beta coefficient: an instrumental variables approach. *Research in Finance* **4**, 128–151.

Ismail, B. E. and Kim, M. K. (1989) On the association of cash-flow variables with market risk: further evidence. *Accounting Review* **64**, 125–136.

Johnson, B. (1979) The cross-sectional stability of financial ratio patterns. *Journal of Financial and Quantitative Analysis* **14**, 1035–1049.

Kanto, A. and Martikainen, T. (1991) A confirmatory test of an *a priori* classification pattern of financial ratios: empirical evidence with U.S. data. *The Finnish Journal of Business Economics* **40**, 22–38.

Kim, J.-B. and Lipka, R. (1991) Effects of accounting choice on the explanation of the market risk in the oil and gas industry. *Journal of Business Finance and Accounting* **18**, 61–84.

Kinnunen, J. (1988) *The time series properties of accrual versus cash-based income variables: empirical evidence from listed Finnish firms.* Proceedings of the Helsinki School of Economics A-58.

Kraus, A. and Litzenberger, R. H. (1976) Skewness preference and the valuation of risk assets. *Journal of Finance* **31**, 1085–1100.

Laurent, C. R. (1979) Improving the efficiency and effectiveness of financial ratio analysis. *Journal of Business Finance and Accounting* **6**, 401–413.

Lev, B. (1974) *Financial Statement Analysis.* Prentice Hall, Inc., Englewood Cliffs, New Jersey.

Livnat, J. and Zarowin, P. (1990) The incremental information content of cash-flow components. *Journal of Accounting and Economics* **13**, 25–46.

Luoma, M. and Ruuhela, R. (1991) Consistency and comovement of financial ratios: a firm-specific approach. *The Finnish Journal of Business Economics* **40**, 39–49.

Martikainen, T. (1990a) *The Individual and Incremental Significance of the Economic Determinants of Stock Returns and Systematic Risk.* Acta Wasaensia 24.

Martikainen, T. (1990b) Modelling stock price behavior by financial ratios. *Rivista di matematica per le scienze economiche e sociali* **11**, 119–138.

Niskanen, J. (1990) *On the information content of accrual-based and cash-based accounting income numbers: their ability to predict investment risk.* Acta Oeconimicae Helsingiensis A 69.

O'Connor, M. C. (1973) On the usefulness of financial ratios to investors in common stock. *The Accounting Review* **48**, 339–352.

Ohlson, J. (1990) A synthesis of security valuation theory and the role of dividends, cash flows and earnings. *Contemporary Accounting Research* **6**, 648–676.

Ou, J. A. and Penman, S. H. (1989) Financial statement analysis and the prediction of stock returns. *Journal of Accounting and Economics* **11**, 295–329.

Pettit, R. R. and Westerfield, R. (1972) A Model of capital asset risk. *Journal of Financial and Quantitative Analysis* **7**, 1649–1677.

Pinches, G. E., Mingo, K. A. and Caruthers, J. K. (1973) The stability of financial patterns in industrial organizations. *Journal of Finance* **28**, 389–396.

Pinches, G. E., Eubank, A. A., Mingo, K. A. and Caruthers, J. K. (1975) The hierarchical classification of financial ratios. *Journal of Business Research* **3**, 295–310.

Pohlman, R. A. and Hollinger, R. D. (1981) Information redundancy in sets of financial ratios. *Journal of Business Finance and Accounting* **8**, 511–528.

Roll, R. (1977) A critique of the asset pricing theory's tests; Part I: on past and potential testability of the theory. *Journal of Financial Economics* **4**, 129–176.

Rosenberg, B. and McKibben, W. (1973) The prediction of systematic and specific risk in common stocks. *Journal of Financial and Quantitative Analysis* **8**, 317–334.

Salmi, T., Virtanen, I. and Yli-Olli, P. (1990) *On the classification of financial ratios: a factor and transformation analysis of accrual, cash flow, and market-based ratios.* Acta Wasaensia. Also published on the World Wide Web as <URL:http:/ /www.uwasa.fi/ ,ts/sera/>.

Stephens, A. and Proffitt, D. (1991) Performance measurement when return distributions are non-symmetric. *Quarterly Journal of Business and Economics* **30**, 23–41.

Sudarsanam, P. S. and Fortune, L. H. (1989) Relative usefulness of accrual-based and cashflow-based earnings in security evaluation: an empirical test. A paper presented to the Annual Conference of the European Accounting Association at the University of Stuttgart, West Germany 5–7 April, 1989.

Wilson, G. P. (1986) The relative information content of accruals and cash flows: combined evidence at the earnings announcement and annual report release date. *Journal of Accounting Research* **24** (Suppl.), 165–199.

Wilson, G. P. (1987) The incremental information content of the accrual and funds components of earnings after controlling for earnings. *The Accounting Review* **62**, 293–322.

Yli-Olli, P. (1983) *Tilinpäätösanalyysissä käytettävien tunnuslukujen luokittelu ja stabiilisuus. (English summary: The empirical classification of financial ratios and the stability of the classification.)* Proceedings of the University of Vaasa, Research Papers 95.

Yli-Olli, P. and Virtanen, I. (1985) *Modelling a financial ratio system on the economy-wide level.* Acta Wasaensia 21.

Yli-Olli, P., and Virtanen, I. (1990) Transformation analysis applied to long-term stability and structural invariance of financial ratio patterns: U.S. vs. Finnish firms. *American Journal of Mathematical and Management Sciences* **10**, 73–125.

Yritystutkimusneuvottelukunta (1990) *Yritystutkimuksen tilinpäätösanalyysi* (The Finnish Committee for Corporate Analysis: *Financial statement analysis*). Gaudeamus, Jyväskylä.

APPENDIX: BASIC STATISTICS OF THE VARIABLES

The entire research period 1974–1984

Variable		Mean	S.D.	Variance	Skewness	Kurtosis
x_1	CR current ratio	1.683	0.562	0.316	2.035	6.200
x_2	QR quick ratio	0.933	0.399	0.159	1.137	2.394
x_3	DI defensive interval measure	100.290	37.979	1442.000	0.826	0.949
x_4	DE debt to equity	3.236	2.026	4.105	2.625	9.042
x_5	LTDE long-term debt to equity	1.618	1.377	1.896	1.940	4.433
x_6	TIE times interest earned	2.092	1.259	1.585	2.615	9.299
x_7	ES earnings to sales	0.020	0.020	0.000	0.477	1.115
x_8	ROA return on assets	0.102	0.027	0.001	0.998	0.917
x_9	ROE return on equity	0.084	0.068	0.005	–0.589	0.804
x_{10}	TAT total assets turnover	1.294	0.737	0.543	1.795	2.647
x_{11}	IT inventory turnover	5.603	7.933	62.930	5.038	27.010
x_{12}	ART accounts receivable turn	8.438	3.953	15.620	1.266	2.003
x_{13}	cash/current debt	0.079	0.057	0.003	1.062	0.521
x_{14}	cash/sales	0.027	0.017	0.000	0.592	–0.284
x_{15}	cash/total assets	0.024	0.016	0.000	0.890	–0.331
x_{16}	cash/total debt	0.038	0.026	0.001	1.157	0.561
x_{17}	cash flow/equity	0.256	0.278	0.077	1.013	1.214
x_{18}	cash flow/sales	0.035	0.035	0.001	0.937	2.100
x_{19}	cash flow/total assets	0.032	0.027	0.001	0.625	0.189
x_{20}	cash flow/total debt	0.052	0.043	0.002	0.512	–0.478
x_{21}	security's beta	0.746	0.336	0.113	0.159	–0.705
x_{22}	return on the security	0.129	0.105	0.011	0.180	1.514
x_{23}	security's total risk (var)	0.091	0.048	0.002	1.137	1.316
x_{24}	skewness of the return	0.218	0.705	0.497	0.271	0.522
x_{25}	kurtosis of the return	0.183	1.274	1.624	1.447	3.351

First subperiod, 1974–1978

Variable		Mean	S.D.	Variance	Skewness	Kurtosis
x_1	CR current ratio	1.598	0.534	0.285	2.233	8.171
x_2	QR quick ratio	0.817	0.380	0.145	0.860	1.922
x_3	DI defensive interval measure	90.310	36.440	1328.000	0.835	0.732
x_4	DE debt to equity	3.010	1.671	2.793	2.331	7.268
x_5	LTDE long-term debt to equity	1.419	1.098	1.205	1.588	2.325
x_6	TIE times interest earned	2.033	1.574	2.477	2.729	8.184
x_7	ES earnings to sales	0.012	0.028	0.001	–0.656	1.579
x_8	ROA return on assets	0.089	0.036	0.001	0.592	0.692
x_9	ROE return on equity	0.045	0.117	0.014	–1.416	3.151
x_{10}	TAT total assets turnover	1.296	0.807	0.651	1.858	3.151
x_{11}	IT inventory turnover	5.223	7.252	52.590	4.785	24.951
x_{12}	ART accounts receivable turn	8.748	4.609	21.240	1.712	4.002
x_{13}	cash/current debt	0.049	0.038	0.001	0.663	–1.038
x_{14}	cash/sales	0.017	0.016	0.000	1.498	1.452
x_{15}	cash/total assets	0.017	0.015	0.000	1.261	0.790
x_{16}	cash/total debt	0.026	0.023	0.001	1.141	0.220
x_{17}	cash flow/equity	0.160	0.279	0.078	–0.160	3.167
x_{18}	cash flow/sales	0.025	0.043	0.002	1.261	5.433
x_{19}	cash flow/total assets	0.023	0.030	0.001	0.377	1.815
x_{20}	cash flow/total debt	0.036	0.044	0.002	–0.111	0.568
x_{21}	security's beta	0.729	0.445	0.198	–0.091	–0.874
x_{22}	return on the security	–0.010	0.152	0.023	1.030	3.264
x_{23}	security's total risk (var)	0.076	0.077	0.006	2.650	9.387
x_{24}	skewness of the return	0.264	0.845	0.714	0.307	–0.091
x_{25}	kurtosis of the return	–0.076	2.024	4.098	0.410	–0.403

Second subperiod, 1978–1984

Variable		Mean	S.D.	Variance	Skewness	Kurtosis
x_1	CR current ratio	1.754	0.646	0.417	1.913	4.436
x_2	QR quick ratio	1.029	0.445	0.198	1.308	2.373
x_3	DI defensive interval measure	108.600	41.62	1732.000	0.787	0.820
x_4	DE debt to equity	3.425	2.430	5.906	2.491	8.121
x_5	LTDE long-term debt to equity	1.783	1.670	2.788	2.046	5.113
x_6	TIE times interest earned	2.141	1.207	1.458	2.351	7.048
x_7	ES earnings to sales	0.026	0.018	0.000	1.057	1.167
x_8	ROA return on assets	0.113	0.026	0.001	0.594	–0.022
x_9	ROE return on equity	0.116	0.061	0.004	0.314	–0.853
x_{10}	TAT total assets turnover	1.293	0.690	0.476	1.786	2.670
x_{11}	IT inventory turnover	5.919	8.528	72.730	5.176	28.145
x_{12}	ART accounts receivable turn	8.179	3.668	13.450	1.051	1.530
x_{13}	cash/current debt	0.104	0.090	0.008	1.593	2.719
x_{14}	cash/sales	0.034	0.023	0.001	0.399	–0.513
x_{15}	cash/total assets	0.030	0.021	0.000	0.759	–0.487
x_{16}	cash/total debt	0.048	0.038	0.001	1.670	3.492
x_{17}	cash flow/equity	0.335	0.331	0.110	1.187	1.092
x_{18}	cash flow/sales	0.044	0.034	0.001	0.571	–0.436
x_{19}	cash flow/total assets	0.039	0.031	0.001	0.516	–0.318
x_{20}	cash flow/total debt	0.065	0.056	0.003	0.829	0.067
x_{21}	security's beta	0.761	0.336	0.113	0.184	–0.422
x_{22}	return on the security	0.244	0.112	0.013	0.317	–0.100
x_{23}	security's total risk (var)	0.072	0.054	0.003	1.300	1.610
x_{24}	skewness of the return	0.250	0.831	0.691	–0.757	0.974
x_{25}	kurtosis of the return	0.065	1.875	3.516	0.678	–0.431