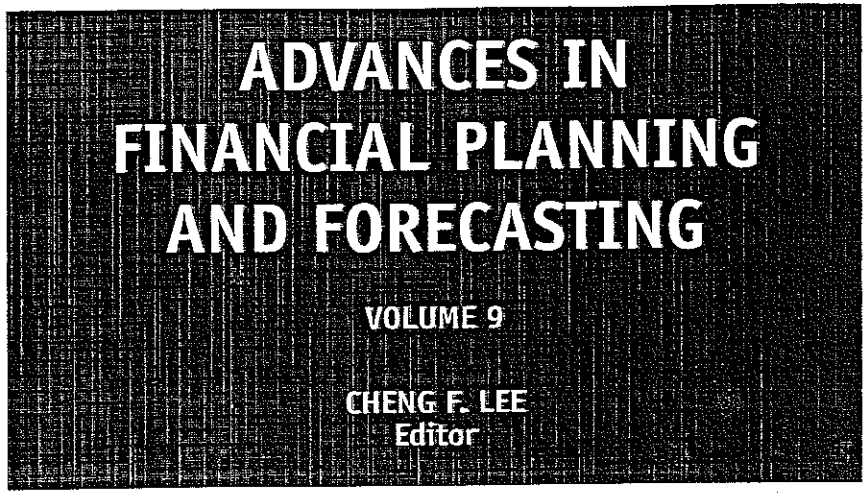

ADVANCES IN FINANCIAL PLANNING AND FORECASTING
VOLUME 9

ADVANCES IN FINANCIAL PLANNING AND FORECASTING

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Janice H. Levin Building, Piscataway, NJ, USA

2000

JAI
An Imprint of Elsevier Science

Amsterdam – London – New York – Oxford – Paris – Shannon – Tokyo

ELSEVIER SCIENCE Inc.
655 Avenue of the Americas
New York, NY 10010, USA

First edition 2000

Library of Congress Cataloging in Publication Data
A catalog record from the Library of Congress has been applied for.

ISBN: 0-7623-0634-3
ISSN: 1046-5847 (Series)

♾ The paper used in this publication meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).
Printed in The Netherlands.

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From equations (22) and (20), it can be seen that:

$$\frac{k_{rf}+(k_m-k_{rf})\beta}{(1-F)^2}>\frac{[k_{rf}+(k_m-k_{rf})\beta]/[1-b]}{(1-F)^2}. \quad (24)$$

The implication of this result is that as flotation costs increase, the cost of external equity capital declines as the earnings retention rate increases.

SUMMARY

The above results imply that in the presence of flotation costs, the cost of external equity can be reduced through the retention of earnings. Equations (19) and (24) demonstrate that the greater the rate of earnings retention, the lower the value of k_e, as long as $F>0$. In this case, dividends are not irrelevant. In the absence of flotation costs, however, dividends and growth (proxied by br) are irrelevant. Regardless of the rate of earnings retention, the costs of internal and external equity are equal if flotation costs are zero. The derived flotation-cost adjusted CAPM (eq. 13) given by:

$$k_e=\frac{k_{rf}+(k_m-k_{rf})\beta}{(1-F)/(1-Fb)} \quad (13)$$

should serve several important functions. First, the model helps address the often raised question of why both of the commonly used cost of equity models cannot be used for both internally and externally generated cost estimates. Additionally, it is often suggested that several models of internal equity cost be estimated and an average of the results be used. This derivation offers the opportunity to do the same with external cost of equity estimates.

ASSOCIATION BETWEEN ACCOUNTING AND MARKET-BASED VARIABLES; A CANONICAL CORRELATION APPROACH WITH U.S. DATA

Timo Salmi, Ilkka Virtanen, Paavo Yli-Olli and Juha-Pekka Kallunki

ABSTRACT

The nature of the association between the firm's accounting and market-based variables is investigated using canonical correlation analysis. The data consists of NYSE and AMEX firms for 1976–1993. A clear relationship between the firm's accounting and stock-market variables is observed. However, the accounting variables making up the relationship vary along time. The decomposed analysis of the association suggests that accrual-based financial ratios are crucial for security analysis. Cash-based financial ratios show increasing relevance over time. The effect of a reduction of the original set of the accounting variables into six key financial ratios is observed. The inclusion of the variance of the stock return into the market-based variable set is found to crucially increase the strength of the association.

Advances in Financial Planning and Forecasting, Volume, 9, pages 97–114.

ISBN: 0–7623–0634-3

INTRODUCTION

The association between the firm's accounting and market-based variables has received much attention in literature. The relative usefulness of alternative accounting variables in explaining and predicting market behavior has been discussed. Much interest has focused on the specific question whether accrual-based or cash-based accounting variables contain more relevant information for security analysis. The question of a sufficiently reduced set of accounting variables for successful security analysis has also arisen. A further related issue is the discussion whether the market-beta is a sufficient measure of securities' riskiness.

The association between the firm's accounting and market-based variables has been approached in several ways. The association between the firm's accounting beta and its security market beta is studied, e.g. by Ball & Brown (1969), Beaver et al. (1970), Gonedes (1973), Bowman (1979) and Ismail & Kim (1989). 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 & Kim (1989) present empirical evidence on the association. These results point to relationships between the firm's accounting and market-based variables, which is the general subject of this paper.

Another approach, with more accounting variables, is taken by Beaver et al. (1970), Pettit & Westerfield (1972), Martikainen (1991), and Kim & Lipka (1991). They seek to establish which single financial ratio, or cluster of financial ratios, best correlate with a security's return and risk. This approach implicitly assumes that the market's evaluation of the firm's performance and financial standing is based on an unvarying set of financial ratios.

Although significant associations have been found in literature, the set of individual accounting variables which best explains the market-based variables varies between studies covering different sample periods. This is not surprising because accounting constructs seek to smooth income over time and focus on historical relationships while market variables are inherently less stable and are forward-looking. In this light we provide new results by introducing a generalized approach to the question of the association.

Canonical correlation analysis is a powerful tool for analyzing the nature of the relationship between two sets of variables. In a multivariate environment of this type the canonical correlation not only gives a quantitative measure for overall association between the two variable sets but also discloses how the association is made up of the individual variables. We show using this approach first applied in this context in Salmi et al. (1997) that the general relationship

between the accounting and the market-based variables as sets is high. We also show that the temporal instability observed in the earlier studies in the relationship between individual accounting and market-based variables is inherent. In other words, it is seen in this paper that the association between the accounting and market-based variables exists but in general terms the association between the individual variables is not stable over time.

Under a closer investigation the question has arisen in literature whether accrual-based or cash-based accounting variables are more closely related to stock return and risk. Wilson (1986), Bowen et al. (1987), Ismail & Kim (1989), Ou & Penman (1989), Holthausen & Larcker (1992) and Cheng et al. (1996), among others, have investigated whether cash-based financial ratios 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 & Kim (1989) came to the conclusion that cash-flow data has the potential to supply additional information on the firm's risk beyond that available from earnings.

There is a trend of increased interest into free cash flows in the practice of security analysis. The tradition of using cash-flow ratios was initiated in Gombola & Ketz (1983). Also, the FASB Statement No. 95 has required since 1987 firm-specific statements disclosing cash flow information. In this light it is to be expected that the importance of the cash based financial ratios in the relationship between the accounting and market-based variables increases over time. In the paper at hand we use the canonical correlations to measure the relative and incremental importance of accrual and cash-based accounting variables to explain market-based variables.

It is commonly believed that investors use only a few key factors in their evaluation of a firm's performance and financial standing. For example Pinches et al. (1973), Johnson (1979), Yli-Olli & Virtanen (1990), and Martikainen et al. (1997) represent financial statement analysis research which seeks 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 results in the factor analysis literature point to the possibility of successfully using a concise set of accounting variables to cover the firm's activities.

The question of the information content of a reduced financial ratio set is important because it is in an investor's interest to consider only a reduced number of key ratios for a cost-efficient investment analysis. In this light it is to be expected that a reduced set of financial ratios would be adequate for an investor's analysis. Thus we also investigate whether the same patterns still

hold for the reduced set as for generalized association between the financial ratios and the security characteristics.

A security's total risk is defined by the variance of the security's return. In risk-return relationship studies there is a continuing controversy whether or not the market beta, as defined by the capital asset pricing model, is a sufficient measure of securities' riskiness (see Fama & French (1992, 1996) and Kothari et al. (1995)). Therefore we apply our approach to see whether the inclusion of the variance, in addition to the security's beta, strengthens the general association between the accounting and the market-based variables. The potential, incremental significance of the variance over the beta has implications on what risk measures are useful for the investors' decision making.

This study contributes to the existing literature in the following ways. The main contribution is to apply canonical correlation analysis to directly investigate the generality and temporal instability of the association between the accounting and market-based variables. Second, we bring further empirical evidence on information content of the accrual-based versus cash-based accounting variables and the changes in their relative importance over time. Finally, this chapter contributes by providing additional evidence about the association between the accounting information and two concepts of the security's risk: beta and variance.

The rest of the chapter is organized as follows. The next section presents the research problems and the methodology. Section three describes the data. The empirical results on the general association between the accounting and market-based variables are covered in Sections four to seven. Section eight concludes the chapter.

RESEARCH HYPOTHESES AND METHODOLOGY

Based on the discussion in the Introduction we formulate and test the following research hypotheses.

(1) There is a general association between the firm's accounting ratios and its stock return and risk, but this association is not temporally stable with regard to the individual variables.
(2) The association with stock return and risk is stronger for accrual-based than for the cash-based financial ratios. The cash-flow set contains incremental information that strengthens over time.
(3) A reduced set of key financial ratios essentially retains the correlation between the firm's accounting ratios and its stock return and risk.

(4) The general correlation between the firm's accounting ratios and its stock return and beta strengthens when the variance is added as a risk measure.

Each of the hypotheses involves investigating the nature of the association between two sets of variables. The canonical correlation analysis facilitates testing all these hypotheses. Canonical correlation analysis can be interpreted as 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 centers on the linear association between one battery of variables, the predictor variables $x_1, x_2, \ldots, x_p$, and another battery of variables, the criterion variables $y_1, y_2, \ldots, y_q$. For the statistical foundations of the canonical correlation analysis, see for example Green (1978, pp. 260–289). For applications of the canonical correlation analysis in accounting research, see, e.g. Salmi et al. (1997). For a brief review of the canonical correlation analysis see Appendix A.

DATA DESCRIPTION

The annual accounting data is retrieved from Compustat tapes for all the December firms listed on the NYSE and AMEX. The stock returns are obtained from CRSP tapes. Our research period from 1976–1993 is divided into three subperiods, 1976–1981, 1982–1987, and 1988–1993 in order to investigate the temporal stability of the associations between the accounting and market-based variables.

Our choice of the accrual-based financial ratios draws on the categorizations presented by Lev (1974) and Foster (1978). The individual ratios are the ones given in Foster (1978, p. 60). They are the current ratio, quick ratio, defensive interval measure, debt to equity, long-term debt to equity, times interest earned, earnings to sales, return on assets, return on equity, total assets turnover, inventory turnover and accounts receivable turnover. The Compustat formulas of the variables (x_1–x_{12}) are given in Appendix B. The cash-based financial ratios (x_{13}–x_{20}) follow Gombola & Ketz (1983). They are cash/current debt, cash/sales, cash/total assets, cash/total debt, cash flow/equity, cash flow/sales, cash flow/total assets, and cash flow/total debt. The values of the financial ratios (x_1–x_{20}) are calculated separately for each subperiod by averaging[1] the annual values of each individual ratio for each firm. This procedure yields three cross-sectional samples.

Prior 1987 cash flows had to be calculated using the balance sheet and the income statement data. For a critical view on deriving the cash-flow

information from the balance sheet and the income statement see Bahnson, Miller & Budge (1996). Since 1987 FASB Statement No. 95 requires disclosing firm-specific cash flows from operations. In our paper the cash-based financial ratios have been calculated from the balance sheet and income statement figures because of the following, obvious reason. To test the temporal stability for entire period under observation, 1976–1993 the balance sheet and income statement approach is the only available option.

The market-based variables (x_{21}–x_{23}) are the mean return on the security, the security's beta, and the total risk (variance) which are calculated from the time series of 72 monthly returns for each of the three subperiods. The market betas are estimated by regressing the stock returns on the market return using the market model. The market return is obtained as the return on the SP500 index.

The sample contains 613 firms in 1976–81, 627 in 1982–87 and 612 in 1988–93. The firms included in the sample have no missing observations of any of the variables. The data was scanned for obvious observation oddities. In the variable times interest earned (x_6) five observations with almost zero denominators were dropped because at a zero denominator the variable loses its validity. A common technical criterion for discarding an observation is exceeding three times the standard deviation from the mean. The five observations removed in our study were far beyond this cut point. The basic statistics of the variables are presented in Appendix C.

EMPIRICAL ASSOCIATION BETWEEN ACCOUNTING AND MARKET-BASED VARIABLES

The results of the canonical correlation analysis with all the accounting ratios (x_1–x_{20}) as the predictors and securities' return (x_{21}) and beta (x_{22}) as the criterion variables are presented in Table 1. The results indicate that there is a clear general association between the firms' accounting and market-based variables. The two canonical correlations between the variable sets are highly significant for all the three periods. The numerical values of the first canonical correlation vary from 0.431 to 0.619, and from 0.293 to 0.499 for the second.

Next consider the structural stability of the association. By stability we mean here whether the content of the canonical variables remains the same over the subperiods. If the content of the canonical variables is not stable this indicates that different combinations of financial ratios are correlated with the market-based variables during the different subperiods.

Table 2 reports the standardized canonical coefficients for the accounting and market-based variables. It is readily seen that while there is a general

Table 1. Canonical Correlations and Their Statistical Significance: Return and Beta vs. All Financial Ratios

	Canonical variables	Canonical correlation	Approximate F	p-value
Panel A	1	0.438	5.430	0.0001
1976–81	2	0.341	4.113	0.0001
Panel B	1	0.619	14.207	0.0001
1982–87	2	0.499	10.588	0.0001
Panel C	1	0.431	4.693	0.0001
1988–93	2	0.293	2.923	0.0001

The pairs of canonical variables 1 and 2 are linear composites of the set of financial ratios and the set of return and beta. The first canonical variable pair is made up by the linear composites yielding the highest correlation.

association between the two sets the association is generated by different accounting variable combinations in the different periods. Even the signs of the canonical coefficients vary between the periods. In other words the structure of the existing association is not stable. However, there is one exception. The contribution of the financial leverage variables has to be considered stable (see the coefficients of v_1 for the variables x_4–x_6 where at least the sign remains). This result is in line with the theoretical considerations of relationship between financial leverage and security risk suggested, e.g. by Hamada (1972).

The results corroborate our first research hypothesis. A general association between the firm's accounting ratios and its stock return and risk is observed. The association is not temporally stable with regard to the individual variables.

RELATIVE INFLUENCE OF ACCRUAL-BASED AND CASH-BASED VARIABLES IN THE ASSOCIATION

Tables 3 and 4 present the results for the accrual-based and cash-based accounting variables when each set is used separately as the predictor of the market-based variables. Since the number of the involved accounting and market-based variables are different in each of the tables, the F-values are not directly comparable.

First it is observed that taken alone both the accrual-based and the cash-based variables are significantly associated with the market-based variables. Of

Table 2. Standardized canonical coefficients

Panel A: Coefficients for the predictor (the accounting) variables

	1976–81		1982–87		1988–93		
	v_1	v_2	v_1	v_2	v_1	v_2	
x_1	–0.063	0.295	–0.128	0.547	0.191	–0.678	current ratio
x_2	0.111	0.430	–0.053	–0.597	–0.114	0.530	quick ratio
x_3	0.901	–0.578	–0.350	0.529	0.381	0.171	defensive interval measure
x_4	0.057	0.096	0.062	–0.320	0.162	–0.759	debt to equity
x_5	0.220	0.312	0.179	0.189	0.492	0.795	long-term debt to equity
x_6	0.428	–0.136	0.070	–0.121	0.013	0.185	times interest earned
x_7	–0.361	–0.177	0.588	–0.557	0.434	–0.548	earnings to sales
x_8	0.798	0.283	0.408	0.912	–0.336	1.315	return on assets
x_9	–0.258	0.736	0.064	–0.327	0.054	–0.527	return on equity
x_{10}	0.009	0.493	–0.018	0.311	–0.186	0.562	total assets turnover
x_{11}	0.154	0.294	–0.057	0.136	–0.063	–0.142	inventory turnover
x_{12}	–0.147	0.112	0.004	–0.122	–0.251	0.005	accounts receivable turnover
x_{13}	0.336	–1.208	–0.115	0.072	0.281	0.520	cash/current debt
x_{14}	–0.455	0.677	0.049	–0.396	–0.778	–0.826	cash/sales
x_{15}	0.507	0.329	0.103	0.412	0.658	–0.298	cash/total assets
x_{16}	–0.671	0.363	0.230	–0.194	–0.239	0.929	cash/total debt
x_{17}	0.216	–0.572	0.074	–0.048	–0.159	0.054	cash flow/equity
x_{18}	–0.495	1.205	–0.140	–0.383	–1.039	0.468	cash flow/sales
x_{19}	–0.195	–0.137	0.259	0.472	1.327	–0.712	cash flow/total assets
x_{20}	–0.477	–0.075	–0.362	–0.304	–0.467	–0.502	cash flow/total debt

Panel B: Coefficients for the criterion (the market-based) variables

	1976–81		1982–87		1988–93		
	w_1	w_2	w_1	w_2	w_1	w_2	
x_{21}	0.594	0.969	0.820	0.581	0.241	0.970	return
x_{22}	0.569	–0.984	–0.492	0.876	0.972	–0.232	security's beta

The table presents the standardized (zero mean, unit variance) canonical coefficients of the original x-variables for the underlying canonical variables v_1, v_2, w_1 and w_2.

the two accounting variable sets the accrual-based set outperforms the cash-based set. However, in the most recent period the cash-based variables are at par with the accrual based variables.

Second, the incremental information provided by the cash-based variables can be observed by comparing Tables 1 and 3. In the first period, the incremental increase in the canonical correlation from the cash-based variables is relatively small. In the second period the cash-based variables contain no incremental information. However, in the most recent period the incremental

Table 3. Canonical correlations and their statistical significance: return and beta vs. accrual-based financial ratios

	Canonical variables	Canonical correlation	Approximate F	p-value
Panel A	1	0.363	5.441	0.0001
1976–81	2	0.252	3.689	0.0001
Panel B	1	0.604	21.609	0.0001
1982–87	2	0.471	15.950	0.0001
Panel C	1	0.313	3.275	0.0001
1988–93	2	0.154	1.322	0.2075

The pairs of canonical variables 1 and 2 are linear composites of the set of financial ratios and the set of return and beta. The first canonical variable pair is made up by the linear composites yielding the highest correlation.

information from the cash-based is crucial. The results indicate that in the most recent period the cash-based variables have gained marked importance. This coincides with the increased interest into free cash flows in the practice of security analysis in line with the tradition initiated in Gombola & Ketz (1983).

To conclude, these results support our second research hypothesis concerning the relative information content of accrual and cash-based financial variables. The accrual-based financial variables contain more information than

Table 4. Canonical correlations and their statistical significance: return and beta vs. cash-based financial ratios

	Canonical variables	Canonical correlation	Approximate F	p-value
Panel A	1	0.212	2.734	0.0003
1976–81	2	0.158	2.216	0.0314
Panel B	1	0.409	13.054	0.0001
1982–87	2	0.349	12.239	0.0001
Panel C	1	0.347	6.234	0.0001
1988–93	2	0.175	2.734	0.0084

The pairs of canonical variables 1 and 2 are linear composites of the set of financial ratios and the set of return and beta. The first canonical variable pair is made up by the linear composites yielding the highest correlation.

the cash-based financial variables. The increase in the information value of the cash-based financial variables over time gets support.

ASSOCIATION WITH THE KEY FINANCIAL RATIOS

Next we consider the effect of reducing the accounting variable set into a set of key financial ratios. Table 5 gives the association results with the following financial ratios: quick ratio (x_2), defensive interval measure (x_3), debt to equity (x_4), return on equity (x_9), total assets turnover (x_{10}) and cash flow/sales (x_{18}). The selection of the accrual-based ratios is based on the classifications in Foster (1978), Lev (1974) and Yli-Olli & Virtanen (1990). Cash flow/sales was selected as the representative for the cash-based variables. Thus the reduced set of financial ratios covers the following financial statement analysis categories: liquidity, dynamic liquidity, leverage, profitability, turnover and cash flows.

Table 5 indicates that even the reduced set of financial ratios holds a crucial amount of information for security analysis. A comparison of Tables 1 and 5 naturally shows a decrease in the information content as a result of the reduction in the predictor variables. A reduction of the number of variables from twenty to six (a 70% reduction) resulted in an average drop of 30 per cent in the canonical correlation coefficients.

To study whether the nature of the association of the key ratios with return and beta changes over time an analysis of the canonical coefficients is performed for the reduced set of financial ratios. The results reported in Table 6 still indicate a temporal instability of the association. In the case of the full

Table 5. Canonical correlations and their statistical significance: return and beta vs. reduced set of financial ratios.

	Canonical variables	Canonical correlation	Approximate F	p-value
Panel A	1	0.324	8.263	0.0001
1976–81	2	0.214	5.821	0.0001
Panel B	1	0.445	17.758	0.0001
1982–87	2	0.304	12.637	0.0001
Panel C	1	0.285	4.771	0.0001
1988–93	2	0.088	0.937	0.4561

The pairs of canonical variables 1 and 2 are linear composites of the set of financial ratios and the set of return and beta. The first canonical variable pair is made up by the linear composites yielding the highest correlation.

Table 6. Standardized canonical coefficients for the key ratios

Panel A: Coefficients for the predictor (the accounting) variables

	1976–81		1982–87		1988–93		
	v_1	v_2	v_1	v_2	v_1	v_2	
x_2	–0.004	0.441	0.089	0.175	0.480	1.177	quick ratio
x_3	0.824	0.091	–0.583	0.029	–0.102	–0.606	defensive interval measure
x_4	0.596	0.295	0.633	0.404	0.791	0.077	debt to equity
x_9	0.058	0.528	0.833	0.504	0.363	–0.638	return on equity
x_{10}	–0.156	0.675	0.083	0.847	0.165	0.402	total assets turnover
x_{18}	–0.861	0.644	0.659	–0.115	–0.539	0.925	cash flow/sales

Panel B: Coefficients for the criterion (the market-based) variables

	1976–81		1982–87		1988–93		
	w_1	w_2	w_1	w_2	w_1	w_2	
x_{21}	0.211	1.117	0.662	0.756	0.546	0.837	return
x_{22}	0.881	–0.718	–0.683	0.737	0.842	–0.539	security's beta

The table presents the standardized (zero mean, unit variance) canonical coefficients of the original x-variables for the underlying canonical variables v_1, v_2, w_1 and w_2.

set of accounting variables in Table 2 only one stable financial-ratio category, financial leverage, was observed. Reducing the set of financial ratios into the six key ratios introduces profitability as another stable financial-ratio category.

To conclude, these results tentatively support third research hypothesis that a reduced set of financial ratios essentially retains an association between accounting and market-based financial ratios. Numerically the strength of the association weakens but on the other hand the temporal stability of the association improves.

EFFECT OF ADDITIONAL RISK MEASURES ON THE ASSOCIATION

Our last question concerns whether the inclusion of total risk (variance) of the returns of individual securities strengthens the empirical association between the financial ratios and the market-based variables. It is theoretically to be expected that the firm-specific financial ratios are related to the unsystematic part of the total risk. Whether the inclusion of the variance crucially increases the strength of the general association between the accounting-based and the market-based variable sets is an empirical question. In an investigation

Table 7. Canonical correlations and their statistical significance: return, beta and variance vs. all financial ratios

	Canonical variables	Canonical correlation	Approximate F	p-value
Panel A	1	0.618	8.630	0.0001
1976–81	2	0.422	4.806	0.0001
	3	0.295	3.147	0.0001
Panel B	1	0.782	17.727	0.0001
1982–87	2	0.450	7.759	0.0001
	3	0.372	5.398	0.0001
Panel C	1	0.600	8.113	0.0001
1988–93	2	0.423	4.707	0.0001
	3	0.286	2.928	0.0001

The pairs of canonical variables 1 to 3 are linear composites of the set of financial ratios and the set of return and beta. The first canonical variable pair is made up by the linear composites yielding the highest correlation.

conducted on thinly-traded security markets such an increase was not observed. See Salmi et al. (1997).

Table 7 reports the results after including the variance to the set of the market-based variables. When the results are compared with Table 1 it is first observed that the level of the association between the accounting variable set and the market-based variable set is now remarkably higher. The first canonical correlation is at least 0.6 for all the periods. Second, also the emerging third canonical correlation is highly significant for all the three periods.

The results for the accrual-based variable set, the cash-based variable set and the reduced accounting variable set show similar increases in the canonical correlations for the extended market-based variable sets. These tables are not included in the paper but they are available from the authors on request.

To conclude, our fourth hypothesis concerning the importance of the variance as a risk measure is strongly supported. This result is in line with investors considering both the systematic and total risk in their investment decisions.

CONCLUSION

This paper investigates the association between the firm's accounting and market-based variables. Four research hypotheses are posed based on the earlier literature on the relationship between accounting information and stock return and risk. The data covers the period from 1976–1993 divided into three six-year subperiods for firms listed on the NYSE and AMEX.

First it is investigated if there is a temporally stable general association between the firm's accounting ratios and its stock return and risk. The results show that such an association exists, but it is structurally unstable. These results indicate that while there is a clear relationship between the firm's accounting and stock-market variables, the accounting variables making up the relationship vary along time. This finding has important implications for investors analyzing financial statement information.

Second, the relative and incremental importance of the accrual-based and cash-based accounting variables in the association is investigated. It is observed that taken alone both the accrual-based and the cash-based variables are significantly associated with the market-based variables. The accrual-based accounting variable set has a stronger relationship with the market-based variable set than the cash-based set. With the exception of the period 1988–93, the incremental information of the cash-based set is negligible. This finding confirms that accrual-based financial ratios are crucial for security analysis and that cash-based financial ratios have increasing relevance.

Third, it is observed that a reduction of the original set of the accounting variables into six key financial ratios retains a significant association. The resulting drop in strength of the association is about one third. This finding, together with the other findings of this paper, supports a view of using a reasonably-sized set of financial variables in security analysis.

Fourth, it is investigated whether the general association between the firm's accounting ratios and its stock return and risk is strengthened when the risk is measured by alternative risk measures. The inclusion of the variance of the stock return into the market-based variable set as a measure of the total risk crucially increases the strength of the association. The appearance of the unsystematic risk in the empirical results is in line with practice of considering firms individually in financial statement analysis.

ACKNOWLEDGMENTS

The comments and suggestions by two anonymous referees are gratefully acknowledged. Our special thanks are due to the Editor, Professor Cheng F. Lee.

NOTE

1. The averaging of ratios was needed to make the three-dimensional data (the variables, cross-sectional variation, inter-temporal variation) two-dimensional. The

averaging 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 three subperiods was used to study the stability over time of the correlation pattern obtained.

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APPENDIX A

A BRIEF REVIEW OF THE CANONICAL CORRELATION ANALYSIS

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 centers on the linear association between one battery of variables, the predictor variables $x_1, x_2, \ldots, x_p$ and another battery of variables, the criterion variables $y_1, y_2, \ldots, y_q$.

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

$$R = \begin{pmatrix} R_{yy} R_{yx} \\ R_{xy} R_{xx} \end{pmatrix} \quad (1)$$

The x and y 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, $i = 1, 2, \ldots, p$, and a (different) linear composite of the y_j-variables, $j = 1, 2, \ldots, q$, 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

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

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

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 composites v and w

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

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.

APPENDIX B

DEFINITIONS OF THE VARIABLES USING COMPUSTAT CODES

Symbol	Variable	Compustat Definition
x_1	current ratio	(4)/(5)
x_2	quick ratio	[(1) + (2)]/(5)
x_3	defensive interval measure	[(4)-(3)]/[(41) + (102) + (189) + (15) + (61)-(50)]
x_4	debt to equity	(181)/(216)
x_5	long-term debt to equity	(9)/(216)
x_6	times interest earned	(13)/(15)
x_7	earnings to sales	(172)/(12)
x_8	return on assets	[(18) + (15)]/[(6)]
x_9	return on equity	(18)/[(216) + (50)]
x_{10}	total assets turnover	(12)/(6)
x_{11}	inventory turnover	(12)/(3)
x_{12}	accounts receivable turnover	(12)/(2)
x_{13}	cash/current debt	(1)/(5)
x_{14}	cash/sales	(1)/(12)
x_{15}	cash/total assets	(1)/(6)
x_{16}	cash/total debt	(1)/(181)
x_{17}	cash flow/equity	[(13)-{d[(4)-(1)]-d(5)}]/(216)
x_{18}	cash flow/sales	[(13)-{d[(4)-(1)]-d(5)}]/(12)
x_{19}	cash flow/total assets	[(13)-{d[(4)-(1)]-d(5)}]/(6)
x_{20}	cash flow/total debt	[(13)-{d[(4)-(1)]-d(5)}]/(181)
x_{21}	return on the security	
x_{22}	security's beta	
x_{23}	security's total risk (variance)	

d(k) denotes the difference of the financial item k.

APPENDIX C

THE BASIC STATISTICS OF THE VARIABLES

	1976–81		1982–87		1988–93	
	mean	std	mean	std	mean	std
x_1	2.202	0.891	1.949	0.971	1.854	1.175
x_2	1.177	0.472	1.125	0.633	1.112	0.909
x_3	0.277	0.223	0.294	0.175	0.312	0.240
x_4	1.396	1.930	1.562	2.017	1.786	1.371
x_5	0.562	0.637	0.653	0.903	0.760	0.750
x_6	15.341	28.039	11.627	31.077	11.783	30.325
x_7	0.053	0.059	0.046	0.069	0.041	0.094
x_8	0.086	0.031	0.070	0.040	0.065	0.047
x_9	0.113	0.149	0.059	0.273	0.071	0.183
x_{10}	1.416	0.740	1.136	0.658	1.088	0.715
x_{11}	11.633	16.018	15.152	24.930	18.925	32.848
x_{12}	10.823	27.378	9.342	17.012	11.503	41.187
x_{13}	0.333	0.288	0.372	0.463	0.380	0.728
x_{14}	0.064	0.080	0.083	0.127	0.086	0.165
x_{15}	0.072	0.057	0.071	0.074	0.066	0.080
x_{16}	0.166	0.169	0.171	0.275	0.163	0.322
x_{17}	0.329	0.290	0.317	0.210	0.346	0.238
x_{18}	0.135	0.102	0.165	0.124	0.165	0.125
x_{19}	0.150	0.060	0.137	0.060	0.130	0.064
x_{20}	0.333	0.203	0.287	0.188	0.256	0.196
mean	0.020	0.012	0.015	0.009	0.015	0.015
beta	1.252	0.451	0.983	0.388	0.847	0.464
vari	0.011	0.007	0.010	0.007	0.010	0.018

FINANCIAL DISTRESS AND FIRM VALUE

Richard B. Whitaker

ABSTRACT

Industry adjusted firm value declines 27.04% in the distress year and 57.07% five years after entry into financial distress. Prior to entry into financial distress, the sample firms performed with their industries. The costs of financial distress increase with the severity of financial distress, reductions in capital expenditures, and the rate of growth of the industry. Cost reducing management actions and higher stockholdings by the board of directors correlate with lower costs of financial distress. The results support the hypothesis that financial distress results in opportunity costs which are significant relative to the tax benefits of debt.

INTRODUCTION

Although financial distress frequently is equated to default, the costs of financial distress are not limited to those firms which default but arise as the likelihood of default increases.[1] Previous studies have noted significant declines in firm value prior to default.[2] A recent study by Andrade & Kaplan (1998) concludes that the costs of financial distress are heavily concentrated in the period following entry into distress but prior to bankruptcy. These findings suggest that understanding the significance of the costs of financial distress warrants further evaluation of these costs in the time period following entry into financial distress.

Advances in Financial Planning and Forecasting, Volume, 9, pages 115–129.

ISBN: 0–7623–0634-3