

FINANCIAL RATIOS AS PREDICTORS OF COMPANY ACQUISITIONS

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Introduction

This paper addresses itself to the following question: Is it possible to predict those companies that fail to survive as independent entities due to acquisition? Attempts to identify and generalize the major causes of acquisition have been generally unsatisfactory, because of the lack of a well defined economic theory of the firm under uncertainty.¹ Notwithstanding this lack of a relevant theory, there exists a number of scattered suggestions in the literature regarding the motives for acquisitions.²

This study seeks to find answers to the following specific empirical questions in relation to listed companies:—

(a) What are the important financial characteristics of acquired companies, and how are these characteristics different from those of companies which are not acquired (i.e., survive)?

(b) Is it possible to generalize that the identification of the possession of certain financial characteristics would suggest that a company is likely to be acquired?

Accordingly, the objective of this study is twofold. First, to examine the profile of financial characteristics of acquired companies, and to determine to what extent, if at all, it is possible to discriminate between acquired and surviving companies. Second, if discrimination is possible, what are the most important distinguishing financial characteristics of the relevant groups of companies.³

In this study, an 'acquisition' refers to the situation where company A acquires more than 50 per cent of the equity of company B. The consequence of this transaction is that the identity of company B is absorbed into company A.⁴ The profile of characteristics of the companies examined are presented as financial ratios, prepared from their published annual statements. Specifically, a set of financial ratios is investigated in an acquisition prediction context wherein a multiple discriminant statistical methodology is employed.

In the following section, the sample design and the data employed are discussed. In addition, the statistical technique adopted, multiple discriminant analysis, is briefly introduced. Section III reviews the empirical results and summarizes the findings and conclusions of the study.

II

The Sample

The study examines the 45 quoted industrial companies that failed to survive due to acquisition in the period, 1968 to 1975 inclusive, and which are identified as having at least five years of published accounts, prior to their acquisition. The majority of the sample companies (35) was acquired in the years, 1971 to 1973 inclusive. For every acquired company in the sample, there is a surviving company from the same period, randomly selected from the Statex Industrial companies. The acquired companies, and the surviving companies which were

adopted as the control group, operated in 11 different industries. The industrial composition⁵ of the total sample appears in Table 1.

The time period chosen has considerable significance for two reasons. First, it represented an era which reflected the popularity of acquisitions in Australia's corporate history. Second, given the mandatory 5 year data requirement, the commencement date of 1968, did not necessitate an examination of published accounts before 1963,

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when the requirements of the 1961 Companies Act became universally adopted. The 1961 Act was designed not only to increase the amount and relevance of financial information presented in the annual accounts, but also to bring into line the differing state regulations regarding disclosure.

The Data

The financial statements of the acquired companies were obtained for up to 5 years prior to acquisition from the Sydney Stock Exchange Research Library. The first year prior to acquisition is defined as the financial year represented by the financial statements immediately prior to the date of acquisition. The second year before acquisition is defined as the financial year preceding the first year. The third, fourth and fifth years are similarly defined. Since the acquisitions occurred from 1968 to 1975 inclusive, the first year before acquisition includes financial statements from an eight-year period, 1967 through to 1974, while the fifth year includes the period, 1963 through to 1970.

The financial statements of the surviving companies (the control group) were obtained for the same financial years as the acquired companies. For example, if the 1970 statements of an acquired company represented year one, the 1970 statements of a surviving company would be assigned to year one, and similarly for the other years before acquisition.

From the standardised financial statements⁶ of the acquired and surviving companies, 12 basic ratios were computed for each company year. These ratios are listed in Table 2 and can be categorised as being representative of profitability-return (01-04), liquidity (05-06), financial policy choices (07-09), valuation ratio (10), 5 year earnings growth (11), and volatility in the 5 year earnings growth trend (12). Essentially, the ratios were chosen from the literature, as they have been posited on a priori grounds as affecting a company's chance of acquisition.

For the total company sample, values of each of the ratios 01 to 10 were computed, (a) for the first year, (b) for the average of the first and second year, (c) for the average of the first to third year, (d) for the average of the first to fourth year, (e) for the average of the first to fifth year. This resulted in 50 ratios for each company. The ratios 11 and 12 were computed by fitting a logarithmic trend to the 5 year E.P.S. series (from the first to the fifth year), adjusted for all capitalization changes. Thus, a total of 52 ratios, representing values over various time spans of the 12 basic ratios given above, were computed to indicate the profile of financial characteristics of each company.

Discriminant Analysis

This study utilizes a multivariate statistical technique known as discriminant analysis, in order to examine the predictive ability of the selected financial characteristics to discriminate between acquired and surviving companies. Discriminant analysis is most appropriate when one is doing exploratory empirical research with only a weakly conceived theory. Originally developed by Fisher,⁷ discriminant analysis deals with a class of statistical problems that focuses on the analysis of groups of populations and/or data sets. More recently, the technique has been used in a number of financial and economic investigations.⁸ In the majority of these studies, a linear model of the form,

$$Z = a_1 X_1 + a_2 X_2 + \dots + a_n X_n$$

was used. The 'a's are called discriminant coefficients and are chosen so as to maximize the ratio of the weighted between-groups variance to the pooled within-groups variance. The coefficients are applied to the variates (the financial characteristics) of each observation (the companies) to determine an observation's Z score. In turn, the size of an observation's Z score, relative to a critical value determines its classificatory group (acquired or surviving group). In most cases this linear form was probably an inappropriate specification due to the lack of homogeneity of the variance — co-variance matrices of the respective groups. When this homogeneity does not exist, a quadratic function is appropriate,⁹ although linear models often give similar results.¹⁰

Quadratic classification rules were found to be appropriate for this study since the test for the equality of group dispersions was rejected.¹¹ In addition, as noted in footnote (9), the statistical tests conducted are based on equal a priori probability of group membership. However, this assumption may not be valid if the a priori probabilities do not fairly represent the population probabilities of acquisition. This appears to be true in our case as there were only 45 acquired companies, compared to some 700 companies which survived during the same period. Nevertheless, when the a priori probabilities were changed to reflect population probabilities, very similar results to the equal a priori probabilities tests were observed.

Finally, in order to reduce the possible sources of 'fit' bias in the application of discriminant analysis, it is important to use a robust validation procedure to determine the accuracy of the classification results obtained from the analysis. The most powerful validation procedure known to the authors for this purpose, is the Lachenbruch¹² hold-out

sample technique. Accordingly, this technique was used in this study to evaluate the classification results.

III

The Empirical Analysis

The results of the discriminant analysis are reported in three stages: (1) based upon pooled data, (2) based upon a cross-sectional study of selected years, and (3) based upon a stepwise procedure to determine the best subset of ratios.

The results of the first stage are based upon data which was pooled across industries and over time. The validity of pooling depends upon certain economic and statistical considerations which are discussed in the sequel.

From an economic point of view, pooling across time could lead to misleading results if there is reason to believe that there were major changes in the economic and institutional environment, and in the nature of acquisition activity over the period of analysis. To overcome this deficiency, stage II of the study analysed each of the 3 years (1971 to 1973) that displayed predominant acquisition activity. A second economic consideration is that the nature of acquisition activity and the dominant motivations for acquisitions may differ amongst industries. Table I demonstrates that even with the industries (e.g. 6 and 9) which evidenced the highest occurrence of acquisition, the actual number of observations is too small to conduct any meaningful statistical analysis. Moreover, the two-digit industry codes are too loosely defined to be useful. A third economic consideration is that pooling does not control for size and age differences amongst the companies investigated. Consequently, if there are observed differences between the ratios of the acquired and surviving companies, these differences may be, at least partially, attributed to size and age differences. However, this study found no strong correlations between the ratios used and total assets, or, age. Finally, it may be argued that some of the above mentioned economic and statistical considerations may be overcome by the use of a paired sample technique. Essentially, the technique would involve matching each acquired company in the sample with a surviving company from the same industry, asset and age group. The objective of a paired sample is to control these effects, if there are a priori reasons to believe that there are systematic differences in these factors between acquired and surviving companies. However, sample stratification by these factors precludes the consideration of their contribution to the prediction of acquisitions,¹³ and it limits the general applicability of any resultant predictive model.

The second stage of the study has already been mentioned as being a cross-sectional analyses of companies acquired in the years, 1971 to 1973. The third stage of the study uses a complete stepwise procedure to determine the best subset of ratios from the ratios examined. The main purpose of selecting ratio subsets is to reduce the size of the original set without appreciable loss in discriminatory power.¹⁴

The following section briefly summarizes the statistical computations and results of the study.

The Results

Within each of the 3 aforementioned stages of the analysis, the statistical work proceeded on four levels: (i) the test of group¹⁵ dispersion equality; (ii) the determination of group means, standard deviations, and the correlation matrices of the ratios employed; (iii) the determination of the discriminant functions, and related significance tests; (iv) the assessment of classification rules.

In general, the results¹⁶ of the pooled sample demonstrated considerable overlap in the financial characteristics of acquired and surviving companies. The results of the three cross-sectional years (1971 to 1973) did not significantly improve upon the results of the pooled data. Consequently, the ability to predict acquisitions on the basis of the selected ratios was poor, particularly in the second to fifth years. The main empirical findings can be summarized by the following observations:—

- (1) The results of the first year prior to acquisition displayed the lowest expected overlap in the financial characteristics of the groups. The ratios that demonstrated the highest discriminatory power, using both the entire ratio set, and the complete stepwise procedure, for assessment of the best subset, were ratios 11 and 12. The total misclassification rate was 23.33 per cent. Moreover, the misclassification rate improved slightly, when only ratios 11 and 12 were used to predict the groups.
- (2) The total misclassification rates for the pooled data in the second to fifth year were: 42.22%; 46.66%; 48.88%, and 48.88% respectively.
- (3) The total misclassification rates for the 3 cross-sectional years was approximately 20% for the first year prior to acquisition. The misclassifications increased to approximately one-third in the second to fifth year.
- (4) The ratios which displayed relatively high discriminatory power, in addition to ratios 11 and 12, were ratios 02 and 09, particularly in the second to fifth year.

- (5) Overall, the rate of misclassification was higher for the acquired companies.
- (6) The acquired companies were uniformly characterized as having a lower average EBIT/Total Assets (Ratio 02) and a higher average dividend payout (Ratio 09). In addition, the 5 year average annual growth rate in E.P.S. (Ratio 11) was significantly lower (1.07%) with the acquired companies, compared to the average for the surviving companies (10.62%). Moreover, the volatility in the 5 year average annual growth rate (Ratio 12) for the acquired companies (62.46%) was significantly higher than the surviving group of companies (7.78%).

In summary, the results suggest that on average, acquired companies were characterized by lower profitability, unstable earnings, and higher dividend

payouts. The latter may reflect an overt pre-occupation by the management of acquired companies for the maintenance of a stable dividend rate, even with declining earning prospects. In addition, the results also raise some interesting questions for further inquiry. For example, the acquired companies may, nevertheless, have failed to survive as a result of eventual failure or bankruptcy.

In conclusion, the results of this inquiry should not be misinterpreted. It is not suggested that financial ratios lack usefulness. This study merely attempted to evaluate a number of ratios which have been suggested in the literature as useful within an acquisition-prediction context, and recognises that there is no well defined theory to direct the design of the study. The evidence of this study within that context is problematic. It suggests that a change of emphasis is desirable.

Footnotes

1 The development of a 'formal' theory of takeovers, in the sense of a unified explanation of what kind of company is acquired has been credited to Robin Marris. Refer to his paper, "A Model of the Managerial Enterprise", *The Quarterly Journal of Economics*, Vol. 77 (May, 1963), pp. 185-209.

2 For example, refer to J.C. Van Horne, *Financial Management and Policy*, 3rd edition, Englewood Cliffs, N.J.: Prentice-Hall, pp. 610-614.

3 It is necessary to emphasise that this study is not concerned with investigating the possibility of discriminating between: (a) the acquiring and acquired companies; (b) the acquiring and non-acquiring companies.

4 A merger may also seem to have the same consequences when companies of disparate size are amalgamated. The distinction between an acquisition and a merger depends upon whether or not the amalgamation involves the creation of a new legal entity in place of two or more existing ones. From an economic point of view, this distinction is quite arbitrary, since the choice of a legal form by which to effect an amalgamation has little economic relevance.

5 The two-digit AASE Industrial code was adopted as there was an insufficient number of companies to utilize the four-digit code.

6 In order to minimize data errors, it was important to standardise the method of collection and assembly of data. Since the surviving companies were a sample of Statex Industrial companies, the acquired companies financial data were collected and assembled in a similar manner to Statex, prior to the computation of their ratios.

7 R.A. Fisher, "The Use of Multiple Measurements in Taxonomic Problems", *Annals of Eugenics*, Vol. 7, (September, 1936), pp. 179-188.

8 For example, E.I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy", *Journal of Finance*, Vol. 23, (September, 1968), pp. 589-609.

9 The quadratic classification rule in test-space is of the form, assign to group 'g' if for all, $j = 1, \dots, k$ and $j \neq g$,

$$X^1 (S_j^{-1} - S_g^{-1}) X - 2X^1 (S_j^{-1} \bar{X}_j - S_g^{-1} \bar{X}_g) + \bar{X}_j^1 S_j^{-1} \bar{X}_j - X^1 S_g^{-1} X_g \bar{X}_g \geq 2 \ln P_{g,j} - \left| \ln S_j S_g^{-1} \right|$$

where X is an (m x 1) observation vector, \bar{X}_g and \bar{X}_j are sample group mean vectors, S is the sample pooled within groups dispersion matrix and $P_{g,j}$ is the ratio of the group a priori probabilities. In our case, we have $g = 2$ groups, $X = 12$ ratios, and the a priori probabilities of a company being assigned to one of the groups is equal (.5) for each group.

10 It is outside the scope of this paper to present a detailed review of discriminant analysis. The reader is referred to T.W. Anderson, *An Introduction to Multivariate Statistical Analysis*, New York: Wiley, 1958.

11 At the 1 per cent level using the 'F' test.

12 This method required the calculation of 180 different classification rules for this study. The number of calculations are determined in the following manner:

$$\sum_{j=1}^N \sum_{g=1}^G C_{jg}$$

where C_{jg} = Company j's financial characteristics in group g, and $j = 1, \dots, N$ are the sample companies. For an explanation of the technique refer to P.A. Lachenbruch, "An Almost Unbiased Method of Obtaining Confidence Intervals for the Probability of Misclassification in Discriminant Analysis", *Biometrics*, (December, 1967), pp. 639-645.

13 For further elaboration on the objectives and short-coming of the paired sample technique, refer to B. Lev and G. Mandelker, "The Micro-Economic Consequences of Corporate Mergers", *Journal of Business*, Vol. 45, (January, 1972), pp. 85-89.

14 The various procedures available for determining an efficient subset of ratios from a larger original listing is discussed by E.I. Altman, *op. cit.*

15 The term 'group' is used to refer to both acquired and surviving companies.

16 It is outside the scope of this paper to present a complete tabulation of the results. The interested reader can obtain a copy of the tabulated results from the authors.

TABLE 1: SUMMARY OF INDUSTRY GROUPS

INDUSTRY CODE	ACQUIRED COMPANIES	SURVIVING COMPANIES
3	1	1
4	1	1
5	5	12
6	9	4
7	4	2
8	2	2
9	8	10
10	6	9
11	5	1
12	2	1
14	2	2

TABLE 2: DESCRIPTION OF FINANCIAL RATIOS

01:	Ord. Earnings After Tax/Ord. Shareholders Funds
02:	EBIT/Total Assets
03:	Ord. Divs./Ord. Shareholders Funds
04:	Operating Income/Operating Assets
05:	Liquid Ratio
06:	Current Ratio
07:	Long Term Debt to Equity
08:	Short Term Debt to Equity
09:	Ord. Divs./Ord. Earnings
10:	Net Tangible Asset Per Share/Share Price
11:	E.P.S. Growth Rate
12:	E.P.S. Growth Rates Volatility