CROSS-SECTIONAL STUDY OF RISK DEFINED BY DEGREE OF DIVERSIFICATION IDENTIFIED USING SEGMENTED ANNUAL REPORTS

By

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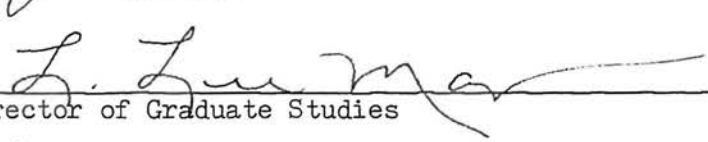

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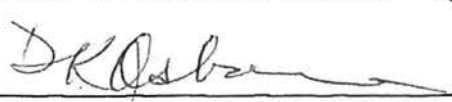

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Title of Study: CROSS-SECTIONAL STUDY OF RISK DEFINED BY DEGREE OF DIVERSIFICATION IDENTIFIED USING SEGMENTED ANNUAL REPORTS

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Scope of Study: This study deals with the relationship between industry risk and diversification. Industry risk and diversification are defined and their relationships are discussed. Previous literature on the use of beta as a measure of risk, segment reporting as a tool for analysis of diversified companies, and the portfolio concept is reviewed and their relevancy to the study is discussed. By using the Financial Accounting Standards Board's Statement 11 on Segmental Disclosure for determining diversification within an industry and using the beta measure as a proxy for industry risk, the relationship was examined in a cross-sectional study for a one-year time period, 1982. A major hypothesis was developed to explain the relationship and several minor hypotheses were developed for the separate regression equations using different diversification measures.

Findings of the Study: The results for the regression models were inconclusive. One of the minor hypothesis was rejected outright and the other two were not significant but indicative of a relationship. Recommendations were made for future studies, such as using a time-series analysis with different definitions of diversification.

ADVISOR'S APPROVAL 

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CHAPTER I

INTRODUCTION TO STUDY

Within the last 15 years, a large shift in the composition of a firm's assets has taken place. Companies that were typically concerned with only a narrowly defined line-of-business have become highly diversified corporations. This trend toward increased diversification has taken place for numerous reasons such as the reduction of business risk, the increase in returns, and the development in complementing industries. Before the middle of the 1960's, most companies diversified either vertically or horizontally within a given industrial catagory. Since then, the conglomerate type firm which operates across numerous, seemingly unrelated business entities has become increasingly more common. Most diversified companies are not involved with many unrelated businesses but operate within a few different segments. These companies still pose the same problem as the conglomerates, how does one analyze a diversified corporation's separate business entities when the only available information is contained in an annual report or 10-K statement?

In 1970, the Financial Accounting Standards Board's Statement Number 11 was developed to require companies involved in different lines-of-business to report their sales and profits derived from these different segments in their annual report. In 1977, a requirement to report assets on segmented basis was added. The advent of this segmental accounting was expected to help in the analysis of a diversified firm through the increased information available. Much controversy has been generated by this rule with conflicting claims as to the value of this information in the evaluation of a firm's risk.

Possible Approaches

According to the American Heritage Dictionary of the English Language, risk can be defined as "the possibility of suffering harm or loss." The definition of risk in a business environment is the uncertainty regarding the expected rate of return from an investment. The three major types of risk in a business environment are business risk, financial risk, and liquidity risk. Business risk is the uncertainty of income flows caused by the nature of the firm's business; financial risk is the uncertainty introduced by the method of financing an investment; and liquidity risk is the uncertainty introduced by the secondary market for an investment. An alternative view of risk has been derived based upon portfolio theory and capital market theory, the work in this field indicates that investors should use an external market measure of risk. This view holds that all rational, profit maximizing investors want to hold a completely diversified portfolio of risky assets, called the market portfolio, and they borrow or lend to arrive at the desired risk level. In this situation, the relevant risk measure of an individual asset is its comovement with the market portfolio. This covariance with the market portfolio is called the asset's systematic risk. In addition, individual assets have variance that is due to unique features called unsystematic risk or diversifiable risk. The relevant risk measure in this study will be systematic risk inherent in a group of risky assets.

The general definition of diversification is found in its root word, diversify. According to the American Heritage Dictionary, diversify is defined as "to extend (activities) into disparate fields. Used of a

business enterprise." Diversification is recognized as the state of being diversified. This study describes diversification in terms of the segment data reported in the individual company's annual report. The diversification of a company is defined by the SIC code of the segments in which the company operates. Any segment's SIC code that differs more than 50 points away from the company's four-digit SIC code results in that segment being defined as diversified. As an example, the SIC code for a company might be 2086 in the Bottled-Canned soft Drink Industry. A segment within that company might operate in the Motion Picture Industry which has a SIC code of 7800. The difference between 2086 and 7800 is over 50, therefore that segment is diversified.

The problem of risk and diversification can be examined in several different ways. A time-series analysis can allow for the examination of shifts in risk over a period of time. This analysis can be particularly useful with changes in the composition of a company over time and the effect that these changes would have upon the company's systematic risk. A cross-sectional study could take the examination of this risk and segmentation across many companies within a single year. This study could examine the level of risk associated with a given level of diversification. The possible approaches in calculating the systematic risk of a company can use return on investment, return on equity or any other return measure which can be compared to a market index of specific measure.

The approach this study will take is a systematic risk measure based upon a return on stock covaried with a market index of stock prices. The study will be a cross-sectional study on the level of risk associated with a given level of diversification.

Problem Motivating This Study

The problem motivating this study is the difficulty in ascertaining the relationship between the systematic risk of a company and the level of diversification for that company. Examining the problem from an industry viewpoint, does risk provide a basis for diversification and does a relationship exist between the level of diversification? The motivation for diversification on a company level might be due to many various factors such as under-utilized facilities, complementary industries, natural development of a company, or return enhancement. Any relationship between risk and diversification might be considered loose, but on an industry level, the relationship might become clearer because of the decreased effect of individual company variations.

A basic investment analysis involves the economy, the industry, and then the company. The relative positions of industries to each other and the comparison of companies within an industry provide much information in the analysis. At the present time, the risk level of an industry and the diversification of that industry has not been examined in a complete manner and this can have a bearing upon the final results of any analysis. This examination of company diversification and risk has a great deal of room for further research and can provide several different avenues on which to proceed.

Purpose of This Study

The purpose of this study is ascertain the relationship between industry risk and diversification. This will be conducted by an examination of the level of diversification and the level of systematic

risk over a variety of companies in different industries using the companies to derive the industry measures. The time will be a one year period and the study will focus upon the relationship which is presumed to exist.

This study will also try to form a basis upon which other studies might be undertaken. This study will be conducted to provide more general results and basic findings.

Theory

The basis of this study is rooted in portfolio theory and the theory of diversification. This theory states that as diversification increases, the level of systematic risk approaches the market risks. The weakness in this approach is that industries can not really be equivalent to portofolios because they represent physical assets rather than financial assets. On a company level, the portfolio approach is not as valid because the company invests both capital and management resouces while an investor allocates only dollars. Also, the investor can vary the extent of his investment while a company either owns a division or not. This study will try to examine the portfolio concept on an industry level. While the protfolio concept cannot always be applied to a given company, this concept will be examined to see whether it can be applied on an industry level.

Hypothesis

Given that the purpose of this study is to examine any relationship between the level of diversification and the level of systematic risk, the hypothesis must relate these two variables. The working hypothesis

is that a relationship exists between the level of diversification and the amount of risk on an industry level. The statistically testable hypothesis, or null hypothesis, is that no such relationship exists. The working hypothesis will be referred to as H_A and the null hypothesis will be Ho.

Each different procedure used to determine diversification yielded a subproblem which required a minor hypothesis. In each subproblem, it was hypothesized that a relationship existed between the risk variable and the diversification variable. In each case, the null hypothesis would be that there is no relationship.

CHAPTER II

SURVEY OF LITERATURE

Introduction

This chapter is a review of the literature relating to the subject under examination. The chapter will be divided into three different sections to deal with the three areas from which this study is based. The three areas are segment reporting in the assessment of risk, the use of the beta coefficient as a measure of risk, and portfolio theory. Segment reporting is the area in which this study was instigated. The advent of segment accounting was expected to allow for a more precise measure of risk for a given company and also facilitate the prediction of earnings and the measurement of diversification away from a company's main line-of-business. The beta coefficient is a measure of systematic risk developed in the last twenty years and is the measure of risk used in this study. Portfolio theory is the basis for most examinations into the relationship between risk and diversification in a portfolio of risky assets. This study will try to relate these three areas by examining the level of risk for inter-industry comparison, signified by beta coefficients, and the level of diversification, gained from segmented reporting in annual reports, and these are related on the basis of portfolio theory.

Segment Reporting in Risk Assessment

The review of the literature involved with the line-of-business reporting is relatively brief due to the recent nature of the topic.

The FASB segment disclosure rule has only been in effect since 1970, as a result, the empirical data generated has been relatively brief. The previous studies conducted have concentrated upon the predictive nature of segment reporting on a longitudenal scale and also upon the effect that segment reporting has had on the assessment of risk. The previous studies did deal with the perception of risk on a company level and the results tended to indicate that segment reporting did provide a more accurate assessment of risk.

In the first study by Kochanek (1), the empirical results obtained suggest that predictions of future earnings were facilitated by the availability of segment data. In addition, firms disclosing subentity data exhibited lower weekly stock variability over time than firms not providing such information, although other factors had more of an effect. Overall, the evidence collected tends to support the position that segmental data does provide a useful source of information for investors.

Collins (2) undertook a study on the value of segmental reporting on the prediction of earnings because of the continued controversy on whether segment sales and profit figures are useful in predicting earnings in a diversified company. There was some basis for questioning the value of such information due to the inconsistencies across firms in defining segments, differences in intersegment transfer pricing policies, and arbitrary cost allocations. Collin's findings suggest that SEC product-line revenue and profit disclosures together with industry sales projections published in various government sources provide significantly more accurate estimates of future total-entity sales and earnings than do those procedures that rely totally on consolidated data.

Horwitz and Kolodny (3) found that SEC disclosure rule did not

provide investors with a significant level of valuable information, however, a study by Simonds and Collins (4) suggested that some shortcomings in the sample selection and hypothesis-testing may have led to the results that were gained. The empirical analysis conducted indicated that the segmental disclosure rule did provide useful information to investors and that the average effect was a downward shift in their assessment of a diversified company's market riskiness.

Collins and Simonds (5) conducted a study that suggested that firms with minimal or no prior segmental disclosure did have significant shifts in their portfolio-level beta.

Beta as a Measure of Risk

The beta coefficient originated in a study by Sharpe (6) to explain the variation of a risky asset to a combination of risky assets. The portion of variation in the single asset explained by the variation in the combination of assets was termed the systematic risk. The rest of the variation being uncorrelated with the combination was termed the unsystematic risk. These risk measures were used in conjuction with a Capital Asset Pricing Model developed by Sharpe.

Blume (7) examined the coefficient of non-diversifiable risk, or beta using two different approaches, the portfolio approach and the equilibrium approach. Elton (8) used one procedure developed in blume along with some other procedures to calculate different beta coefficients and to examine their accuracy in forecasting.

The results of these studies and others developed into a uniform measure of the systematic risk of a risky asset. The mathematically defined model is:

$$B_i = \frac{\text{Covariance } (R_i, R_m)}{\text{Variance } (R_m)}$$

Three major assumptions of the beta model are:

1. The responsiveness of the asset's or portfolio's returns to economic events. This responsiveness is measured as the covariance of the asset's rate of return with that of the market (covariance (R_i, R_m)).
2. The relationship of the firm's basic characteristics (such as its debt level).
3. The general uncertainty attached by investors to macroeconomic events (such as changes in the level of oil prices), described as the variance of the market (R_m).[1]

Portfolio Theory

One of the major reasons that investors hold portfolios of assets, rather than individual assets, is because of the opportunities a portfolio offers for reducing risks. Studies by Markowitz (9 and 10) provide a model in which

> a single asset or portfolio of assets is considered to be "efficient" if no other asset or portfolio of assets offers higher expected return with the same (or lower) risk or lower risk with the same (or higher) expected return.[2]

Smith and Schreiner (11) applied the portfolio approach to conglomerate diversification and they concluded that the portfolio approach would prove useful as an additional tool for conglomerate management. The shortcomings in this approach were that a conglomerate invests both capital and management resources, that a conglomerate either acquires or does not acquire, and that a conglomerate cannot easily divest a division. In spite of these shortcomings, the portfolio model could still be applied to the conglomerates.

[1]Diana R. Harrington, Modern Portfolio Theory and The Capital Asset Pricing Model (Englewood Cliffs, CA: Prentice-Hill, Inc.) p 69.

[2]Harry Markowitz, Portfolio Selection: Efficient Diversification of Investments (New York: John Wiley and Sons. Inc. 1959)

Summary

This study will relate these three different areas in an attempt to determine the relationship between the level of systematic risk and the level of diversification on an industry level. The segmental disclosure rule provides the information necessary for determining the level of diversification in individual companies and different industry classifications. The beta coefficient determines the level of systematic risk carried by a given industrial classification and the portfolio approach provides the basis of this examination to see whether the relationship is a valid one.

ENDNOTES

1. Kochanek, R., "Segmental Financial Disclosure and Security Prices," The Accounting Review, (Spring 1977): 245-258.

2. Collins, D. W., "Predicting Earnings with Sub-Entity Data: Some Further Evidence," Journal of Accounting Research, (Spring 1976): 163-177.

3. Horwitz, B. and R. Kolodny, "Line of Business Reporting and Security Prices: An Analysis of an SEC Disclosure Rule," Bell Journal of Economics, (Spring 1977): 234-249.

4. Collins, D. W. and R. R. Simonds, "Line of Business Reporting a and Security Prices: An Analysis of an SEC Disclosure Rule: Comment," Bell Journal of Economics, (Autumn 1978): 646-658.

5. Collins, D. W. and R. R. Simonds, "SEC Line-of-Business Disclosure and Market Risk Adjustment," Journal of Accounting Research, (Autumn 1979): 352-382.

6. Sharpe, William F., "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance, (September 1964): 425-442.

7. Blume, Marshall, "On the Assessment of Risk," Journal of Finance, (March 1971): 1-10.

8. Elton, Edwin J., M. J. Gruber, and T. J. Urich, "Are Betas Best," Journal of Finance, (December 1978): 1375-1384.

9. Markowitz, Harry, "Portfolio Selection," Journal of Finance, (March 1952): 77-91.

10. Markowitz, Harry, Portfolio Selection. Efficient Diversification of Investment, (New York: John Wiley and Sons, Inc. 1959).

11. Smith, K. and J. Schreiner, "A Portfolio Analysis of Conglomerate Diversification," Journal of Finance, (June 1969): 413-427.

CHAPTER III

RESEARCH METHODOLOGY

Overview

This chapter will provide the necessary framework of the study. An overview of the research methodology will start the chapter with a brief composite of the different areas of the design including the selection process and relevant theory. The selection of the industrial classifications and companies within these industries will be reviewed within the context of the study. Then the relevant terms will be defined in a specific manner to facilitate an examination of the subject under study. The process of gathering the data is reviewed and the support for the measurement process is also described.

This study is to be a cross-sectional study over many industries in one year time period. The year from which the data was compiled is 1982. Fifteen industrial classifications were chosen and the companies within these industrial classifications were the subjects from which the data on diversification was taken. A beta coefficient was used as a measure of the systematic risk of an industry while the level of diversification was measured by the percent of industry sales from diversified segments within that industry, the number of segments per company, or the number of diversified companies divided by the total companies within each industry. A company segment is defined as diversified if that segment's SIC code differs more than 50 points on the company's four-digit SIC code.

Each industrial classification is assumed to be composite of all

individual companies within that industry and the average of all the companies within an industry will be a proxy figure for that industry. The data requirements for each industry consists of returns on common stock, percent of sales derived from diversified segments within the industry. The lack of data on all companies within an industrial classification requires amalgamation of all available data from sources such as annual reports. Some information is also available from data tapes on the Oklahoma State University computer system such as the company returns. The separate data files for each industrial classification include the return files calculated from the CRSP tapes and files on the level of diversification with that industry calculated from the annual reports. A data file for returns on the market is also calculated.

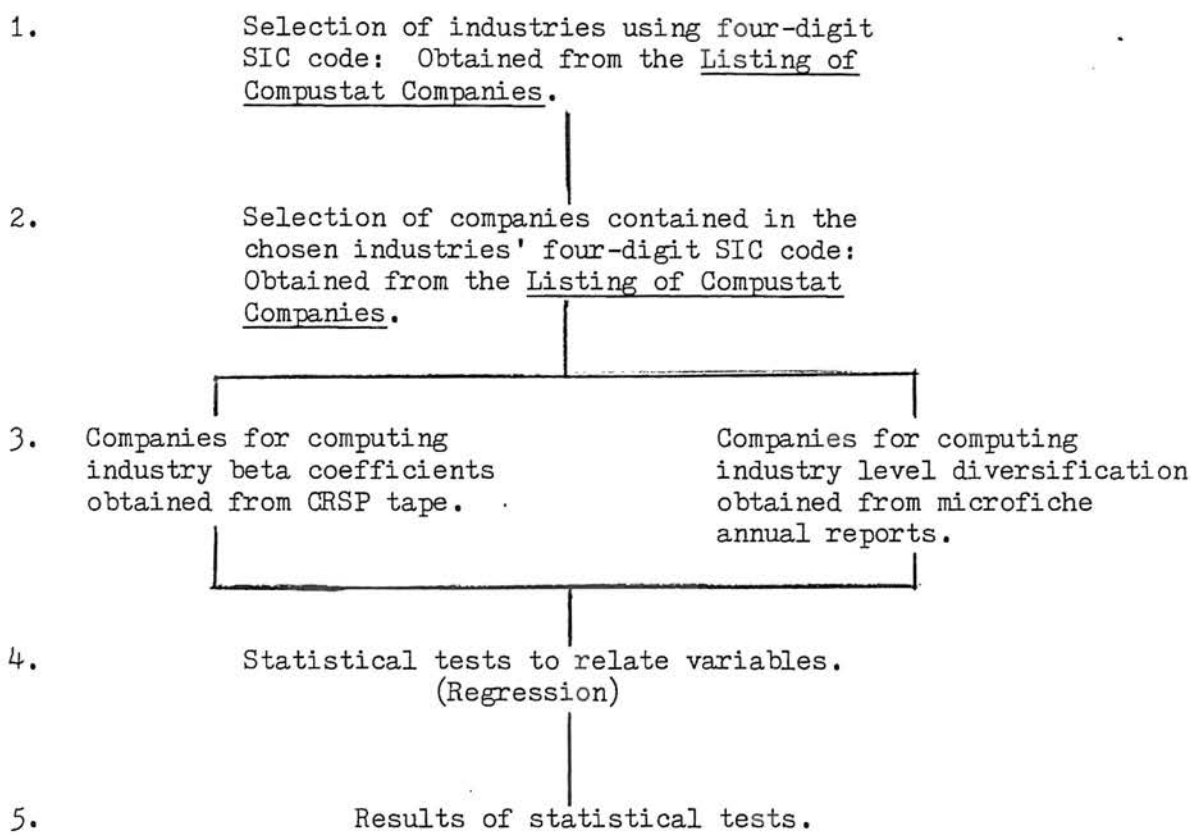
Selection of Sample

The selection process started with the selection of the industries over which the examination would take place and then the selection of the companies within the industries was obtained from the Compustat Listing. Figure 1, describes the steps in which the selection and examination were performed. This section will describe the procedure used in selecting the sample and the basis for the selection.

The selection of the industries was a nonrandom sample based upon number of companies in each industrial classification and type of industry. The industries were selected from The Listing of Compustat Companies available from the University Computer Center. The requirement for each industry was that there be a sufficient number of companies for the purpose of dertermining the level of diversification. This requirement is needed due to the lack of availability for some company data and also to have

FIGURE 1

Flow Chart of the Selection and Testing Process



a wide enough sample of companies in each industry so that the data obtained will not be biased to a major degree by individual company variations. The selection of the industries was also based upon the cyclical nature of each industrial classification. Fifteen industries were selected; six of the industries were selected from noncyclical, stable growth industries and nine were chosen from cyclical, mature industries. In Table 1, a list of the industries selected in included.

The selection of companies was from The Listing of Compustat Companies and the companies listed in each industrial classification under the four-digit SEC code were as available for all the different calculations. The total number of companies obtained from the listing was 341. A listing of companies was then obtained from the tape developed by the Center for Research in Security Prices; these companies were matched with the compustat listing and then used to calculate the beta coefficients. The CRSP tape only contained companies listed on the New York Stock Exchange, as a result, only 241 companies were used in the beta calculations. The information on diversification for each company was obtained from their 1982 annual reports. Due to the availability of the annual reports for each company on microfiche, only 237 companies were used in determining the amount of diversification. The number of companies for each industry can be found in Table 2.

Definition of Terms

The measure of risk used for this study is the beta coefficient. The beta coefficient measures the systematic risk of an asset or group of assets, systematic risk being the risk that cannot be diversified or the amount that returns vary simultaneously with the market.

TABLE 1

List of Selected Industries by SIC Code

Growth and Non-Cyclical Industries	SIC
Food and Kindred Products	2000
Bottled-Canned Soft Drinks	2086
Drugs	2830
Electronic Computing Equipment	3573
Semi-Conductors and Related Devices	3674
Surgical and Medical Instruments	3841

Mature, Cyclical Industries	SIC
Textile Mill Products	2200
Lumber and Wood Products	2400
Paper and Allied Products	2600
Chemicals and Allied Products	2800
Rubber and Miscellaneous Plastic Products	3000
Blast Furnaces and Steel Works	3310
General Industrial Machinery and Equipment	3560
Household Appliances	3630
Motor-Vehicle Parts-Accessory	3714

Source: The Listing of Compustat Companies- 1981

TABLE 2

The Number of Companies in Each Industry Used for Calculations

Industry	Compustat[1] Companies	Beta[2] Companies	Diversification[3] Companies
Food and Kindred Products	17	15	12
Bottled-Canned Soft Drinks	7	7	5
Drugs	29	24	23
Electronic Computing Equip.	46	29	31
Semi-Conductors and Related	11	4	5
Surgical and Med. Instr.	16	9	14
Textile Mill Products	29	17	20
Chemical and Allied Products	18	18	14
Rubber and Misc. Products	15	12	11
Blast Furnaces and Steel	42	33	28
Household Appliances	12	10	6
Motor-Vehicle Parts	24	15	16
Lumber and Wood Products	14	8	7
Paper and Allied Products	27	22	17
Industrial Mach. and Equip.	34	18	7
	341	241	237

Note: The number of companies used for the calculation of the industry beta and for the industry figures on the level of diversification varied according to availability.

1 Number of companies contained in the Listing of Compustat Companies in each selected industry.

2 Number of companies contained on the CRSP tapes from those selected from the Compustat Listing. Used to calculate the industry betas.

3 Number of companies with annual reports contained in the OSU files. Companies were selected from those in the Compustat Listing. Used to calculate the diversification variables.

Mathematically, beta is defined as:

$$B_j = \frac{\text{Covariance } (R_j, R_m)}{\text{Variance } (R_m)}$$

R_j = return on asset j

R_m = return on the market

Covariance (R_j, R_m) = the responsiveness of an asset's rate of return to the market's rate of return

Variance (R_m) = the uncertainty attached to economic events

Beta can also be defined as the slope of an asset's characteristic line with the market.

In this study, the returns for each company were obtained from the CRSP Monthly Return Tape. The returns are defined as the change in the total value if an investment in common stock over some period such as a month per dollar of initial investment. The monthly return used contains all dividends for a given stock. The industry returns were calculated by averaging all companies in the industry for a given time period.

The market returns were obtained from the CRSP Monthly Market Index. These returns were the returns, including dividends, on an equally-weighted market portfolio (including all NYSE stock). This equally-weighted return is defined as the weighted sum of the returns, including dividends, on all the stocks listed on the NYSE. The weights are all the same: 1/n.

The industry return and market return were then regressed to obtain the beta coefficient. The beta being the slope of the industry's characteristic line. The number of observations used was 120 for the industry and market returns. This time period represents ten years, extending from 1972 to 1981.

The measure of diversification is derived from information obtained from the individual company's annual report. The requirement for the reporting of segment sales, profits, and assets was implemeted by the Financial Accounting Standards Board for the purpose of evaluating the extent on which a company operates in different business definitions. In this study, the definition of business segments required the use of SIC code found in the compustat listing. The segments that were defined as diversified were those business segments that were more than fifty points away from the companies main line-of-business on a four-digit SIC code. This was done because many companies' main business lines are related through the production of the end products and cannot be considered a diversified segment.

Data for the different measures of diversification was obtained from the annual reports. The data gathered was the fraction of segment sales to industry sales, the number of business segments per company, and the number of companies with diversified segments. All the data gathered was computed on a relative basis rather than an absolute basis. This was done to eliminate any bias due to the size of the industry or the relative size of the companies in each industry. The different measures were used to provide a variety of measures as a means to decrease any bias that might be present in a specific measure.

The segment sales divided by industry sales is a measure that provides an overall picture of the dependency on sales for the diversified segments. As an example, the Food and Kindred Products industry had total sales from the companies chosen in that industry totaling $47,608,672,000 and sales from the diversified segments within that industry totaled $10,755,027,000. This measure would yield 10,755,027,000/47,608,672,000

= .2238. All this procedure did was take all the reported sales for the diversified segments divided by a total of all reported company sales. The bias this measure could come from would be extremely large segment sales from one company in relation to the other companies in the industry.

Another measure was the number of segments per company, including the main line-of-business segment. An example of this measure, also in the Food and Kindred Products industry, would be 29 total segments divided by 13 companies. The computed figure, 29/13 = 2.23077, was used as one of the proxies for industry diversification for this industry. The bias present in this measure is the effect that highly diversified companies would have on the total measure.

The final measure is the number of companies that have diversified segments divided by the total number of companies. This figure yields 7/13 = .538462 which is a relatively simple, unbiased measure of the level of diversification.

How Data Was Gathered

As stated earlier in this paper, the data was gathered from a variety of sources. The CRSP tapes are widely accepted as data bases for research into stock prices. The use of these tapes provides a uniform source of data for calculations in this study. The calculations of returns is easily replicable and provides consistent results. A ten-year period was used for the beta calculation for the purpose of having a long enough time period to cover a couple of business cycles but not too long that the data is not relevant to the current situation, monthly returns were used to provide a basic time period for returns and also allow for a sufficient number of observations to make the beta calculation statistically

significant.

The segment data was obtained from microfiche copies of the individual company's annual reports. These microfiche annual reports were available from the Oklahoma State Library in the Non-Book room. For the purpose of this study, the company's 1982 sales for segment and company levels were defined as the sales reported on reporting dates between July 1982 and June 1983. This was done to provide a uniform basis for the gathering of company data. Not all companies selected from the compustat listing had annual reports available on microfiche. Some did not have a recent annual report on file while others did not have any annual reports in microfiche. This lack of available data will effect the quality of the data used but there was a sufficient number of companies for each industry to provide the data needed.

Support for the Measurement Process

The support for the measurement process is a function of its reliability and validity. The reliability is the extent that similar results will be obtained following the same measurement procedure used in this study. The validity for the study is the extent to which differences found with a measuring tool reflect true differences among those being tested. Any study that cannot provide adequate reliability and validity lacks an essential part of a valid research project.

The reliability of this study can be evaluated upon the stability and equivalence inherent in its measurement process. The stability of this study can be considered to be strong. Consistent results can be obtained by following the measurement process enumerated previously

and staying within the confines of the definitions used in this paper. Any deviation away from the measurement process will effect the stability of any following study. The equivalence of this study is the extent that the results found can be replicated by subsequent investigators. The equivalence of this study is dependent upon how closely the definitions of this study are followed. The areas in which problems might arise are in the definitions of beta or the business segments.

The types of internal validity that can classify the relevant information used in the evaluation of the validity of a study are content, criterion-related and construct. The content validity of this study is the extent in which provides adequate coverage of the relationship between risk and diversification within the confines of the stated purpose. Since this study contains a fairly representative sample of the population under study within the limits of the study, content validiy can be considered sufficient. The criterion-related validity deals with the concurrent and predictive powers of this study. Four qualities must be examined to evaluate the criterion-related validity:

1. Relevancy
2. Freedom from Bias
3. Reliability
4. Availability

An attempt to improve this measure of validity was conducted by including three measures of diversification. Each different measures was evaluated on these criteria and in this was the validity could be examined. The use of the number of diversified companies divided by total companies provides this study with the highest degree of criterion-related validity. The construct validity deals with the abstract nature of some possible theory. Due to the basis upon which this study is based on, beta as a

risk measure and segments as a measure of diversification, the construct validity of the project is sufficient.

CHAPTER IV

RESULTS OF STUDY

Introduction

In this chapter, the statistical tests will be conducted and the results obtained will be discussed. The first section presents the data necessary to conduct the statistical tests and the manner in which the data was computed. This data includes the computed beta as a measure of the systematic risk for each industry and also the level of diversification for each industrial classification. The results of the statistical tests are then presented and a description of the analysis conducted is included. A statement of the results and discussion of what the results actually mean are followed by a discussion of the results related to the topic under study. The results are then related to the hypothesis and the conclusions that can be drawn from the results and the implications of these conclusions are discussed. The limitations of the study are then considered.

Presentation of Data

A beta coefficient was calculated for each industry using an average of company returns in that industry regressed with the returns on the market index. The beta figures ranged from 1.510684 for the Electronic Computing industry down to .657115 for the Drug industry. A presentation of the beta coefficients for each selected industry is found in Table 3 and the regression results can be found in Appendix A. An explanation of the regression models in the appendices can be found in Figure 2. The betas were calculated using 120 observations of monthly

TABLE 3

List of Industry Beta Coefficients

Industry	Beta
Drugs	.657115
Food and Kindred Products	.678854
Chemicals and Allied Products	.808688
Textile Mill Products	.847351
Household Appliances	.912467
Blast Furnaces and Steel Works	.929656
Paper and Allied Products	.945218
Rubber and Miscellaneous Plastic Products	.954590
Surgical and Medical Instruments	1.015050
Motor-Vehicle Parts-Accessory	1.026144
Bottled-Canned Soft Drinks	1.038890
General Industrial Machinery and Equipment	1.091093
Lumber and Wood Products	1.114460
Semi-conductors and Related Devices	1.355700
Electronic Computing	1.510684

FIGURE 2

Explanation of Regression Models

Dependent Variable: Household Appliances

Source	DF	Sum/Squares[1]	Mean Square[2]	F Value[3]	Prob.[4]
Model	1	0.39693724	0.39693724	203.41	.0001
Error	118	0.23026771	0.00195142		
Total	119	0.62720496			

R-Square= .632867[5] C.V.= 560.3101

Parameter[6]	Estimate[7]	T For Ho[8]	Prob. Ho	Std Error
Intercept	-0.00255127	-0.62	0.5348	0.00409844
Market	0.91246726	14.26	0.0001	0.06397818

[1] Minimum value of the sum of squares

[2] Sum of squares/ DF

[3] Test statistic for large samples and models

[4] Chance that null hypothesis is correct

[5] Goodness of fit of the model- amount of variation explained

[6] The variable in the regression model being measured.

[7] Estimate of the parameter

[8] Statistical test for the parameters

returns from a ten year period and the regression results were obtained using the SAS statistical program.

The determination of the level of diversification for each industry is calculated through three different procedures. These different procedures were used to provide different measures of a variable that is not easily defined. No universally accepted measure of diversification is currently available for individual industries so these procedures were developed in order to provide some degree in which the measures can be depended upon to accurately measure for what they were designed.

The procedures used were the total diversified segment sales within an industry divided by the total sales within that industry, the number of diversified segments plus the main business segments for every company within that industry divided by the total number of companies, and the number of companies with diversified segments divided by the total number of companies. These procedures will determine the different variables for the level of diversification and the variables will be denoted by SALES for the segment sales procudeure, SEGMENT for the diversified segment procedure, and COMPSEG for the procedure using the companies with diversified segments.

The figures for the variable SALES ranged from a high rate of diversification of .567531 for the Chemical and Allied Products industry to a low rate of .008834 for the Rubber and Miscellaneous Plastic Products. This measure can be biased by individual companies if they have a large sales level relative to the rest of the companies in the industry.

The level of diversification using the variable SEGMENT has some different ranges. The high rate of diversification was shown by the Household Appliances industry with a level of 3.00 and the low level of

1.1667 by the Electronic Computing industries. The bias that could be found in this measure is from the effect that any highly diversified, conglomerate type company would have upon this measure.

The last procedure that computed the variable COMPSEG was a relatively unbiased estimate of diversification. This measure yielded a high of .785714 for the Chemical and Allied Products industry and a low of .100 for the Textile Mill Products industry. The industry diversification variables can be found in Table 4.

Presentation of Results

The results of the linear regression procedures used can be found in Table 5 and the entire regression model for each variable is in Appendix B. The results for the linear regression model using the variable SALES regressed with the beta coefficient can be summed up by the general linear regression equation.

$$\text{SALES} = .24558154 - .05829196\ (\text{beta})$$

The results for the variable SEGMENT regressed with the beta can be summed up in the equation.

$$\text{SEGMENT} = 2.93492915 - 1.15471627\ (\text{beta})$$

The variable COMPSEG regressed with the beta results in the equation

$$\text{COMPSEG} = .7629836 - .40944740\ (\text{beta})$$

These results do not reflect the significance of the numbers and can only be an indication of the relationship.

How the Analysis was Conducted

The analysis used for this study was a general linear regression model. Three different procedures were used with the beta coefficient

TABLE 4

Calculated Industry Diversification Variables

Industry	SALES	SEGMENT	COMPSEG
Drugs	.145029	1.69565	.347826
Food and Kindred Products	.223876	2.23077	.538462
Chemical and Allied Prod.	.567531	2.85714	.785714
Textile Mill Products	.048290	1.25000	.100000
Household Appliances	.205231	3.00000	.666666
Blast Furnaces and Steel	.256327	2.25000	.464286
Paper and Allied Prod.	.012019	1.23529	.176471
Rubber and Misc. Plastic Prod.	.008834	1.18182	.090909
Surgical and Medical Instr.	.299444	1.29412	.176471
Motor-Vehicle Parts-Accessory	.495620	2.12500	.625000
Bottled-Canned Soft Drinks	.078070	2.40000	.600000
General Industrial Mach. & Equip	.053306	1.37500	.125000
Lumber and Wood Products	.060685	1.42857	.428571
Semiconductors and Rel. Devices	.023266	1.16666	.166666
Electronic Computing	.337882	1.33333	.133333

TABLE 5

General Regression Results for Risk/Diversification

Dependent Variable	Independent Variable	Slope	Intercept	Prob. Ho
SALES	beta	-.05829196	.24558154	.7918
SEGMENT	beta	-1.15471627	2.93492915	.1268
COMPSEG	beta	-.40944740	.76829836	.1543

being the indepedent variable in all three procedures. The three dependent variables for the procedure were SALES, SEGMENT, and COMPSEG. The results were generated by SAS and the analysis was conducted from the General Linear Models Procedure.

A simple regression model was used because the purpose of this study was to investigate the relationship of risk and diversification. The most effective way of ascertaining a relationship between two variables is by the use of a simple regression model. If the simple model is found ineffective, further research can develop more complex model.

Statement of Results

The results of this study were found through the SAS General Linear Models Procedure. The three relationships studied were SALES and beta, SEGMENT and beta, and COMPSEG and beta; the results were obtained for each relationship. The findings for each will be included below.

The relationship between SALES and beta has been found to consist of a slope of -.05829196 which signifies a slight negative relationship between the two variables. The R-square is .005556 which signifies that only .5556% of the variation in the sales variable can be accounted for by the beta coefficient. This is a very low figure and shows that a very weak relationship exists. A definite lack of any significant results exists for this relationship. The General Linear Models Procedure has an F value of only .07 and the chance that no relationship exists is .7918.

The relationship between SEGMENT and beta was calculated to be a slope of -1.15471627 which is indicative of a negative relationship between the two variables. An R-square of .169946 signifies that only 16.9946% of the variation in the dependent variable, SEGMENT, can be

accounted for by the independent variable, beta. The F-value for the model is 2.66 which translates into the probability that no relationship exists is .1268.

The final procedure involves the relationship between COMPSEG and beta. The calculated slope is -.40944740 which indicates that a negative relationship exists. The R-square is .149655 which shows that the variable beta only accounts for 14.9655% of the variation in companies. The F-value is 2.29 which means that the chance of there being no relationship between the two variables is .1543.

Discussion

The findings on all three different diversification variables show that the relationships that exist with the risk variable, beta, are not well-defined. Differences do exist in the regression models examined over the range of diversification variables and this clearly shows up in the results. The differences amongst the variables indicate that some measures have more importance than others.

The use of industry segment sales with beta is ineffective in determining the expected diversification that an industry should carry in relation to their given risk. Ordinarily, one might expect that the diversified sales in relation to industry sales would be a good estimate of an industry's diversification, but this measure does have some drawbacks that greatly lessen its effectiveness. The segment sales of an industry can be effected by sales from and extremely large company in relation to the rest of the companies in and industry. As a result of this bias, segment sales have little power in a regression model with beta.

The number of segments per company is of more use in a risk-diversification model. Of the three variables used in determining diversification, this measure comes closest to providing significant results. This model does provide an indication that the risk-diversification relationship does exist and that this relationship is a negative one with the beta coefficient.

Similar results were obtained using the number of companies with segments regressed with the beta coefficient. This model also indicated that a negative relationship exists. The results were tempered by the lack of significance so no conclusions can be drawn from the findings.

Relation of Results to Hypothesis

The results of two of the diversification variables indicate that a relationship could exist between risk and diversification on an industry level. The original hypothesis is that a relationship exists between the level of diversification and the level of risk as measured by the beta. The null hypothesis was that no relationahip exists and this is the hypothesis that was tested. The results of the regression equation is a measure of the relationship between two variables.

One measure of diversification, SALES, provides no indication of any relationship between risk and diversification. The evidence does not allow the null hypothesis to be rejected and the conclusion is that there is no relationship between segment sales and beta. No support is found for the working hypothesis.

The other two variables provide some indication of a relationship. While the null hypothesis cannot be rejected, there is substantial evidence that a relationship does exist. The level at which the null

hypothesis would be rejected is probability less than or equal to .05 and in this study the level of significance associated with COMPSEG was .1543 and SEGMENT was .1268. What these levels indicate is that while the evidence is not strong enough to reject the null hypothesis, there is a strong indication that this relationship does exist. Sufficient support for the hypothesis exists to warrant further investigation but not enough support exists to draw conclusions.

Implications

The contribution to current practices cannot accurately be measured at the present time. Due to the lack of significant results, practical uses are not viable. The results do lend themselves to some conjecture over the practical uses of these findings. Taking a broad-based view of industries for investment purposes, an analysis can take an expected relationship and compare specific industries. The error notwithstanding, an industry can be expected to fall into a catagory where then an evaluation can be made.

The possibilities for future research are extensive. First, a study with more depth can be instigated into specific areas of the risk-diversification relationship. A study that includes more industries into its sample should be able to gain more conclusive results. Second, a study using more multiple regression analysis should be able to establish a relationship in which more the risk and diversification can be included. Third, a time-series analysis could be conducted to study any possible trends in risk over diversified industries or diversification over riskier industries. Many offshoots of this study could be examined for further benefits.

Limitations of Study

The biases inherent in parts of the study limited the effectiveness of this examination to some extent. The bias in the selection of the sample was unavoidable given the circumstances but nonetheless important in the evaluation of this study. Only New York Stock Exchange companies were included in the beta calculations and typically, only strong well-established publically traded companies belong to this exchange. Many other companies involved in the industries are traded on the American Exchange, over-the-counter, or are privately held. This bias might tend to moderate the beta measures. The selection of companies for the diversification measure was dependent upon the availability of the specific companies in the OSU libraries. The companies available in the library were more randomly scattered in there but the original selection from the Listing of Compustat Companies was dependent upon listing on a major exchange so the companies were also usually available in the library.

The biases in the measures of diversification have been briefly mentioned before. The segment sales in relation to the industry was subject to undue influence from company size. The number of segment's per company was also influenced to an extent by widely diversified companies. The least biased measure was obtained through the number of diversified companies in each industry. This measure tended to eliminate any biases from size or scale.

Some other possible limitations of this study were the different reasons for diversification. Individual companies diversify for many different reasons. Diversification might be a function of maturity, similar product lines. unused production capacity, technological similarity,

marketing mesh, risk reduction, or return enhancement. The reason this study was conducted on the industry level was to counteract the specific companies effect on why they diversified. The reasoning was that on a company level, diversification might be due to many factors, but on an industry level, a trend could be detected.

The lack of data provided more limitations on this study. A broader, deeper study might have been able to provide conclusive results but the data and time limitations precluded a more comprehensive investigation into the subject. Further study using segment profits or assets could be done but the conditions in which these are obtained must be standardised before consistent results could be obtained. Since the information on diversification was found in annual reports, the reporting of segment profits and assets can be affected by the method of calculation used by the individual companies.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was an examination into the risk-diversification relationship on an industry level. Any relationship was to be determined using a simple regression model and the significance of the results was to be indicative of the strength of the relationship. The regression model was comprised of two variables, a risk variable and a diversification variable. The risk measure used in this study was a beta coefficient and three different measures were used for the diversification variable; segment sales divided by industry sales, number of segments per company, and the number of diversified companies divided by total companies.

The data used for calculation of beta coefficient was obtained from a computer tape in the OSU computer system. The beta was calculated using an average of returns in a given industry regressed with the return on a market index. The period from which the returns were obtained was the ten year period preceding 1982.

The measures for diversification were obtained from annual reports of the individual companies fould in the OSU microfiche library. The calculations were based on the available companies and the year in which the data was taken was the period between July 1982 and June 1983.

The different measures of diversification were then regressed with the beta coefficients, the beta being the independent variable and the results of the regression were used in the analysis of the relationship. The results for the segment sales regression model was inconclusive and

no relationship could be ascertained. The results of the number of segments showed more of a relationship but the results were not conclusive as was the number of diversified segments.

As a result of these inconclusive results, no conclusion can be drawn regarding the overall relationship between risk and diversification on an industry level. The results proved to be inconclusive at the level of a .05 chance of the null hypothesis being correct, but the results for two of the measures indicate that a relationship does exist with only a .15 chance of the null hypothesis being correct. This does show that further research is required for a more in-depth analysis of this relationship.

The value of this study is not negated by this lack of conclusive result but this lack only illustrates the point that further research is necessary. That research can develop different measures of the level of diversification. Other studies could incorporate more variables into a model to determine expected diversification in an industry such as the maturity of the industry, the expected returns, and technological adaptability toward various diverse segments.

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APPENDIX A

General Linear Regression Models

Models for Industry Betas

Dependent Variable: Household Appliances

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.39693724	0.39693724	203.41	.0001
Error	118	0.23026771	0.00195142		
Total	119	0.62720496			

R-Square = .632867 C.V. = 560.3101

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00255127	-0.62	0.5348	0.00409844
Market	0.91246726	14.26	0.0001	0.06397818

Dependent Variable: Motor-Vehicle Parts-Acessor

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.50200015	0.50200015	458.72	.0001
Error	118	0.12913240	0.00109434		
Total	119	0.63113256			

R-Square = .795396 C.V. = 350.5243

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00229779	-0.75	0.4555	0.00306916
Market	1.02614395	21.42	0.0001	0.04791075

Dependent Variable: Food and Kindred Products

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.21970501	0.21970501	220.30	.0001
Error	118	0.11767979	0.00099729		
Total	119	0.33738479			

R-Square = .651200 C.V. = 343.9926

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.00141678	0.48	0.6296	0.00292990
Market	0.67885394	14.84	0.0001	0.04573685

Dependent Variable: Textile Mill Products

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.34230584	0.34230584	246.21	.0001
Error	118	0.16405481	0.00139030		
Total	119	0.50636065			

R-Square = .676012 C.V. = 467.1192

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00170833	-0.49	0.6223	0.00345836
Market	0.84735134	15.69	0.0001	0.05400200

Dependent Variable: Electronic Computing Equipment

Source	DF	Sum/Sqares	Mean Square	F Value	Prob
Model	1	1.08801352	1.08801352	431.52	.0001
Error	118	0.29751704	0.00252133		
Total	119	1.38553055			

R-Square = .785269 C.V. = 331.1240

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00211231	-0.45	0.6511	0.00465862
Market	1.51068359	20.77	0.0001	0.07272292

Dependent Variable: Blast Furnaces and Steel Works

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.41203272	0.41203272	357.58	.0001
Error	118	0.13596887	0.00115228		
Total	119	0.54800159			

R-Square = .751882 C.V. = 241.1104

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.00344685	1.09	0.2760	0.00314935
Market	0.92965588	18.91	0.0001	0.04916263

Dependent Variable: Drugs

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.20585899	0.20585899	85.33	.0001
Error	118	0.28468679	0.00241260		
Total	119	0.49054578			

R-Square = .419653 C.V. = 671.2868

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00019796	-0.04	0.9654	0.00455707
Market	0.65711485	9.24	0.0001	0.07113757

Dependent Variable: Paper and Allied Products

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.42594298	0.42594298	424.58	.0001
Error	118	0.11837968	0.00100322		
Total	119	0.54432266			

R-Square = .782519 C.V. = 277.6134

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.00059942	0.20	0.8387	0.00293860
Market	0.94521824	20.61	0.0001	0.04587266

Dependent Variable: Chemicals and Allied Products

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.31178136	0.31178136	317.56	.0001
Error	118	0.11585414	0.00098181		
Total	119	0.42763550			

R-Square = .729082 C.V. = 298.4041

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.00125207	0.43	0.6675	0.00290708
Market	0.80868883	17.82	0.0001	0.04538069

Dependent Variable: General Industrial Machinery and Equipment

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.56755915	0.56755915	1065.70	.0001
Error	118	0.06284302	0.000532570		
Total	119	0.63040217			

R-Square = .900313 C.V. = 167.9394

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.00126342	0.59	0.5563	0.00214107
Market	1.09108341	32.65	0.0001	0.03342288

Dependent Variable: Rubber and Miscellaneous Plastic Products

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.43442699	0.43442699	365.12	.0001
Error	118	0.14039990	0.00118983		
Total	119	0.57482689			

R-Square = .755753 C.V. = 398.4207

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00225930	-0.71	0.4816	0.00320026
Market	0.95458535	19.11	0.0001	0.04995728

Dependent Variable: Surgical and Medical Instruments

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.49164445	0.49164445	294.89	.0001
Error	118	0.19673146	0.00166722		
Total	119	0.68837592			

R-Square = .714209 C.V. = 695.1521

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00573989	-1.52	0.1324	0.00378825
Market	1.01550470	17.17	0.0001	0.05913604

Dependent Variable: Lumber and Wood Products

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.59212702	0.59212702	276.15	.0001
Error	118	0.25301738	0.00214422		
Total	119	0.84514440			

R-Square = 700622 C.V. = 454.9357

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00256681	-0.60	0.5513	0.00429613
Market	1.11445825	16.62	0.0001	0.06706417

Dependent Variable: Bottled-Canned Soft Drinks

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.51454378	0.51454378	282.08	.0001
Error	118	0.21524774	0.00182413		
Total	119	0.72979152			

R-Square = .70506 C.V. = 365.2930

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	-0.00018909	-0.05	0.9620	0.00396252
Market	1.03888513	16.80	0.0001	0.06185640

Dependent Variable: Semiconductors and Related Devices

Source	DF	Sum/Squares	Mean Square	F Value	Prob
Model	1	0.88914465	0.88914465	131.09	.0001
Error	118	0.80035069	0.00678263		
Total	119	1.68949535			

R-Square = .526278 C.V. = 412.8682

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.00432932	0.57	0.5721	0.00764086
Market	1.36565996	11.45	0.0001	0.11927668

APPENDIX B

General Linear Regression Models

Relationships Between Variables

Dependant Variable: SALES

Source	DF	Sum/Squares	Mean Square	F Value	Prob.
Model	1	0.00243265	0.00243265	0.07	.7918
Error	13	0.43548602	0.03349123		
Total	14	0.43781868			

R-Square= .005556 C.V.= 97.5024

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.24558154	1.12	0.2844	0.21992439
Beta	-0.05829196	-0.27	0.7918	0.21628887

Dependant Variable: SEGMENT

Source	DF	Sum/Squares	Mean Square	F Value	Prob.
Model	1	0.95458227	0.95458227	2.66	.1268
Error	13	4.66239589	0.35864584		
Total	14	5.61697816			

R-Square= 0.169946 C.V.= 33.4897

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	2.93492915	4.08	0.0013	0.71968215
Beta	-1.15471627	-1.63	0.1268	0.70778524

Dependant Variable: COMPSEG

Source	DF	Sum/Squares	Mean Square	F Value	Prob.
Model	1	0.12002150	0.12002150	2.29	.1543
Error	13	0.68196851	0.05245912		
Total	14	0.80199001			

R-Square= .149655 C.V.= 63.3245

Parameter	Estimate	T For Ho	Prob. Ho	Std Error
Intercept	0.76829836	2.79	0.0153	0.27524429
Beta	-0.40944740	-1.51	0.1543	0.27069429

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