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PRIMARY DIMENSIONS OF CHANGE IN THE FINANCIAL CONDITIONS OF DEFENSE INDUSTRY FIRMS

by

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The Department of Defense and its budget has been subject to many changes over the last decade. The change in the Department of Defense's budget effects the financial condition of defense industry firms. These defense industries are critical to the Department of Defense, so their financial condition is of a vital concern. The purpose of this thesis was to analyze the financial data of defense industry firms to investigate whether change in financial condition within the defense industry, occurs along stable, identifiable dimensions. The research sample included fifty defense industry firms selected from the top one hundred Department of Defense contractors. Financial data of these firms covered the 1983 to 1992 time period. The analyses conducted involved examination of measures of change for thirty-six financial ratios. Factor analysis procedures were conducted to identify relationships that exist between these ratio changes. The results of the analyses provided evidence that change in financial condition occurs along six dimensions. These dimensions are independent of one another and represent aspects of a firm's financial condition. Specific ratios are identified to represent these dimensions. Collectively, these dimensions and the representative ratios provide a framework for conducting analysis of changes in financial condition.

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PRIMARY DIMENSIONS OF CHANGE
IN THE FINANCIAL CONDITIONS
OF DEFENSE INDUSTRY FIRMS

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ABSTRACT

The Department of Defense and its budget has been subject to many changes over the last decade. The change in the Department of Defense's budget effects the financial condition of defense industry firms. These defense industries are critical to the Department of Defense, so their financial condition is of a vital concern. The purpose of this thesis was to analyze the financial data of defense industry firms to investigate whether change in financial condition within the defense industry, occurs along stable, identifiable dimensions. The research sample included fifty defense industry firms selected from the top one hundred Department of Defense contractors. Financial data of these firms covered the 1983 to 1992 time period. The analyses conducted involved examination of measures of change for thirty-six financial ratios. Factor analysis procedures were conducted to identify relationships that exist between these ratio changes. The results of the analyses provided evidence that change in financial condition occurs along six dimensions. These dimensions are independent of one another and represent aspects of a firm's financial condition. Specific ratios are identified to represent these dimensions. Collectively, these dimensions and the representative ratios provide a framework for conducting analysis of changes in financial condition.

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I. INTRODUCTION

A. BACKGROUND

With the down sizing of the military and its budget, how the Department of Defense spends money is of particular concern. One of the areas which makes for large amounts of DoD spending is contracts with defense industry firms. These defense industries are critical to the military and so is their financial stability. Since the financial stability of many firms is in question with the defense spending reductions, the DoD is faced with making contract choice decisions based on the survivability of firms. To ensure financial stability is taken into consideration, the DoD does financial analysis of the defense industry firms. The analyses rely on financial ratios which in turn provide indicators of the financial condition of the firms. The results of these analyses are made part of the decision process. This study will investigate the fundamental dimensions of financial condition within the defense industry. Thus it provides a foundation for conducting financial analyses of defense industry firms.

Previous studies have identified fundamental dimensions of financial condition both for firms in general and for defense industry firms specifically. The findings indicated that there are seven fundamental dimensions of financial condition (including such familiar aspects of financial condition as profitability, liquidity and solvency) and that many common financial ratios reflect these fundamental dimensions. These past studies have adopted a "static" view of the problem. Specifically, the dimensions of financial condition have been analyzed by looking at financial ratios and financial condition at specific points in time. The question of whether financial condition changes over time along the same or similar fundamental dimensions has not been investigated. The focus of this study is to take a "dynamic" view and document dimensions of changes in financial conditions, as reflected in the pattern of changes in financial ratios. This study will investigate a sample of defense industry firms and their financial condition with the objective of determining whether change in financial condition within the industry occurs along stable identifiable financial dimensions.

B. OBJECTIVES AND METHODOLOGY

The objective of this thesis is to identify the primary dimensions of change in financial conditions of defense industry firms. The approach will start with a review of the literature on financial dimensions and financial analysis. Financial data for a sample of defense industry firms has been collected by previous studies. This data base contains the financial information for fifty defense industry firms during a ten year time period from 1983 to 1992. By using past studies and the current DoD instruction a set of financial ratios will be identified for the analysis of the research question. To do the analysis, statistical tests will be designed to evaluate the dimensions of change for identified ratios. This will be conducted by factor analysis using a statistical package application. The final step will be to draw a conclusion and document the results in the thesis.

C. THE RESEARCH QUESTIONS

The methodology of this thesis is designed to analyze and provide preliminary answers to the following Primary Research Question (PRQ) and the five Subsidiary Research Questions (SRQ):

1. Primary Research Question (PRQ)

(PRQ) What are the primary dimensions of changes in financial conditions for defense industry firms?

2. Subsidiary Research Questions (SRQ)

(SRQ 1) Are these dimensions of change stable over time?

(SRQ 2) Are the dimensions of change and representative ratios consistent during periods of economic growth and decline?

(SRQ 3) What individual ratios are most highly associated with each dimension of change?

(SRQ 4) Are these representative ratios consistent over time?

(SRQ 5) Are the dimensions of change related to the dimensions of financial condition?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

The purpose of this thesis is to analyze the financial data of defense industry firms to conclude whether or not there are dimensions of change associated with financial conditions. To do this an existing data base will be used. The database consists of financial information for fifty defense industry firms over a ten year time period. The analysis to be conducted with this financial data will include factor analysis of financial ratios. The output of the analysis will be a description of systematic patterns exhibited by measures of changes in financial condition for defense industry firms. Thus, the thesis is a study of aspects of financial condition and characteristics of financial ratios within the defense industry as a whole. It is not an analysis of the financial condition of individual firms within the industry.

E. LITERATURE REVIEW

To conduct this research prior studies and instructions will be used to build a foundation for the analysis. Studies by Pinches, Mingo and Caruthers [Ref. 1], Pinches, Eubank, Mingo and Caruthers [Ref. 2] and Chen and Shimerda [Ref. 3] will be used as background for understanding financial ratio categorization. These will be further discussed in Chapter II and are also essential for understanding the methodology to be used in the analysis of this thesis. Another study by Ketz, Doogar and Jensen [Ref. 4] will be cited for a description of the process of evaluating performance with financial ratios. A final study to be reviewed will be an instruction used by the DoD [Ref. 5] which provides a guideline for applying financial analysis to the Defense Industry firms and the DoD.

F. ORGANIZATION OF STUDY

The remainder of this thesis will include Chapters II through V. Chapter II will be a further examination of prior literature mentioned above and the theoretical framework. Chapter III will be a discussion of methodology, including the basis for the selection of financial ratios to be used in the statistical tests. Chapter IV will be a discussion of the empirical analysis. This will include the discussion of the factor analysis used to generate the findings. Finally, Chapter V will conclude the study by discussing the results and applications of the research.

II. LITERATURE REVIEW

A. OBJECTIVES

The objective of this chapter is to review literature that will be used in the subsequent chapters of this thesis. This will begin with an introduction of financial ratio analysis and its function in the DoD. The manner in which financial analysis is conducted by the DoD will be followed by a discussion on traditional financial ratio theory. Four studies will then be discussed that challenge the concepts of traditional financial ratio theory by identifying specific findings.

B. INTRODUCTION

The financial statement information provided by firms has been subject to many areas of study. One of the most prevalent areas of study is the analysis of financial ratios. Financial ratios provide decision makers with valuable information that may be used for evaluating performance, predicting future behavior and comparing different firms. The conclusions of ratio analysis have widespread potential. Therefore, many studies have been conducted to evaluate the meaning of financial ratios. The rationale is this will lead to better conclusions for the decision makers.

1. DoD Financial Analysis

The manner in which the DoD conducts financial analysis of defense industry firms is another area of research. This is a brief overview of a DoD organization that performs financial analysis in conjunction with its mission. The Defense Contract Management Command (DCMC) was established in 1991 after a reorganization effort of other commands. DCMC is geographically split into five districts throughout the United States. The extensive functions of the DCMC are promulgated in the Federal Acquisition Regulation (FAR), some of its functions include insight into contractor purchasing systems, manufacturing surveillance, quality assurance, Cost/Schedule Control Systems Criteria (C/SCSC) and work measurement practices [Ref. 8]. The area of particular interest for this thesis is the function DCMC executes in the financial analysis of defense industry firms.

The financial analysis conducted by the DCMC was summarized in a guide [Ref. 5] under the Preaward Survey Process (PAS). The PAS is actually a team of analysts which comply with certain requirements and laws to perform a survey of the potential firm. The guide specifically refers to the analyst's assessment of a firm as a judgement call which is derived from thorough analysis. The analysis should consist of techniques referred to in the guide, with the analyst personal expertise used in the final decision [Ref. 5]. The techniques referred to in the guide consist of reviewing vertical and horizontal analysis, trend analysis and ratio analysis with a thorough review of calculating specific financial ratios. The financial ratio analysis is the area of concern for this study. Ultimately the analysis conducted is reported on an all encompassing form required for the PAS. The Standard Form 1407 (SF1407) is as prescribed in the FAR. Some specifics of the form consist of listing the standard balance sheet information and the calculations from three specific financial ratios. They are the Current Ratio, the Quick Ratio and the Total Liabilities to Net Worth Ratio [Ref. 5]. As discussed earlier the analyst responsible for the form may use additional information and there is an area to include this analysis. Describing the additional information which may be included in this area is not standard and would be too varied to specify. The required information and the three specific financial ratios are standard and will be pertinent for the DoD's description of a firm's financial condition.

2. Traditional Financial Theory

Financial theory often classifies financial ratios into five categories. They are: (1) Short Term Liquidity; (2) Debt Management; (3) Operating; (4) Profitability; and (5) Stockholder ratios [Ref. 6]. The ratios which make up these traditional categories may vary. However, the meaning of the categories to decision makers is often the same. Eskew and Jensen [Ref. 6] describe Short Term Liquidity ratios as measurements of a firm's ability to meet its short term obligations as they mature. Debt Management ratios are measurements of a firm's ability to meet obligations involving debt. Operating ratios are measurements of a firm's intensity of use of its assets. Profitability ratios are measurements of the contribution of elements of operations to a firm's profit or the relationship of profit to total investment and stockholder investment. Stockholder ratios are measurements of a firm's performance and

stock returns that are relevant to investors' decisions. The ratios that make up these categories, according to Eskew and Jensen [Ref. 6], are shown in Table 1.

Classification:	Financial Ratio:
Short Term Liquidity	Current Ratio = Current Assets / Current Liabilities Quick Ratio = Quick Assets / Current Liabilities
Debt Management	Times Interest Earned Ratio = (Net Income + Interest + Taxes) / Interest Payments Debt to Equity Ratio = Total Debt / Total Equity Debt to Total Assets Ratio = Total Debt / Total Assets Long-term Debt to Equity Ratio = Long-term Debt / Total Equity Long-Term Debt to Total Assets Ratio = Long-term Debt / Total Assets
Operating	Accounts Receivables Turnover Ratio = Net Credit Sales/ Average Accounts Receivable Inventory Turnover Ratio = Cost of Goods Sold / Average Inventory Asset Turnover Ratio = Net Sales / Average Total Assets
Profitability	Gross Margin Ratio = Gross Margin / Net Sales Operating Income Ratio = Operating Income / Net Sales Net Income Ratio = Net Income / Net Sales Return on Assets Ratio = Net Income + Interest (Net of Tax) / Average Total Assets Return on Equity Ratio = Net.Income / Average Equity
Stockholder	Earnings Per Share Ratio = (Net Income - Pref. Dividends) / Avg. Shares Outstanding Dividend Yield Ratio = Dividends per Share / Market Price per Share Dividend Payout Ratio = Dividends per Share / Earnings per Share Price Earnings Ratio = Market Price per Share / Earnings per Share

Table 1.

There are studies that challenge the traditional theory of financial ratio categorization and propose an empirical classification of financial ratios. These studies start with the premise that empirical classifications would lead to more meaningful analysis for the decision makers. The following will be a review of the methodology and conclusions reached by these studies. The methodology and findings of these prior studies will form the foundation for the analysis of this thesis.

C. EMPIRICAL DIMENSIONS OF FINANCIAL CONDITIONS

The numerous financial ratios available has led to empirical studies in the classification and categorization of these ratios. The findings of such empirical studies would enable an analyst to better define the dimensions of financial conditions. Before discussing the findings

of these studies, it is necessary to understand a technique common to them. The studies have developed an empirically based classification using factor analysis. This methodology allows the analyst to take into account the empirical relationship that exist among financial ratios [Ref. 1].

1. The Factor Analysis Methodology

Factor analysis used in the studies is a means of data reduction through correlation techniques. Within a data set of variables, factor analysis enables identification of underlying patterns of relationships. The data then may be manipulated and rearranged to identify a smaller sets of factors which account for the interrelations in the data [Ref. 7].

According to Kim [Ref. 7], the preparation of a correlation matrix is the first step in factor analysis. This involves defining the relevant variables and selecting the appropriate measures of association. Factor analysis is conducted on the correlations between the variables. The second step in factor analysis is constructing a new set of variables on the basis of the interrelations between the existing variables. This is accomplished with a mathematical transformation of the original data, to structure a new set of variables, which are referred to as factors. The final step to factor analysis is rotating the factors into terminal factors. This is accomplished using orthogonal or oblique rotational methods. These are used to achieve a simpler and more theoretically meaningful factor patterns. These factors are then recognized independently of one another based on their interrelation. The factors are then often referred to as orthogonal. This process is intended to render the possibility of data reduction. The defined factors are the particular combination of variables that account for more of the variance in the data as a whole than any other linear combination of variables. The inferred factors are based fundamentally on the idea that the observed correlations are mainly the results of some underlying regularity in the data. Common factors are variables that are influenced by determinants which are shared by other variables in the set. Unique factors are those that do not share a relationship among variables. The method used is completely dependent on the research being conducted. A more detailed description is not necessary to review of the following studies. [Ref. 7]

2. Financial Ratio Classification Results of Prior Studies

a. Pinches, Mingo and Caruthers

In the study by Pinches, Mingo and Caruthers [Ref. 1] seven independent patterns of financial ratios were concluded to exist. Factor analysis, was used to isolate the factors from the financial ratios. Data covered the years 1951, 1957, 1963 and 1969 for two hundred twenty-one industrial firms. A total of forty-eight separate financial ratios were used. The results of the factor analysis identified seven factors. The seven factors were then classified as: (1) Return on Investment; (2) Capital Intensiveness; (3) Inventory Intensiveness; (4) Financial Leverage; (5) Receivables Intensiveness; (6) Short Term Liquidity; and (7) Cash Position. The financial ratios that make up these seven categories are those financial ratios that have the most information from the original data. See Table 2 [Ref. 1].

The financial ratios most highly correlated within each classification from Table 2 are: (1) Return on Investment - Net Income/Net Worth, (2) Capital Intensiveness - Sale/Total Assets, (3) Inventory Intensiveness - Inventory/Sales, (4) Financial Leverage - Debt/Total Capital, (5) Receivables Intensiveness - Receivables/Inventory, (6) Short Term Liquidity - Current Assets/Current Liabilities, (7) Cash Position - Cash/Fund Expenditures. Consistency of the factor loading across the years indicated Financial Leverage was the most stable and Capital Intensiveness was the least stable. This prompted further analysis to confirm the stability of the classifications over the 1951 to 1969 time period. This was done by performing separate factor analyses for the years the first period 1951-1957, the second period 1957-1963, the third period 1963-1969 and the summary period 1951-1969. This process yielded factor loadings for each time period as depicted in Table 3 [Ref. 1]. A factor's stability could then be determined by looking at how closely correlated the factor loadings were for the periods. It was confirmed Financial Leverage was the most stable. Capital Intensiveness and Receivables Intensiveness were the least stable. [Ref. 1]

Classification:	Financial Ratio:
Return on Investment	Total Income / Sales
	Cash Flow / Total Assets
	Cash Flow / Net Worth
	Total Income / Total Assets
	Net Income / Total Assets
	Net Income / Net Worth
	EBIT / Total Assets
	EBIT / Sales
	Cash Flow / Total Capital
Capital Intensiveness	Cash Flow / Sales
	Total Income / Sales
	Net Income / Sales
	Current Liabilities / Net Plant
	Working Capital / Total Assets
	Current Assets / Total Assets
	Quick Assets / Total Assets
	Current Assets / Sales
	Sales / Total Assets
	Cost of Goods Sold / Inventory
	EBIT / Sales
	Sales / Net Plant
	Sales / Total Capital
Inventory Intensiveness	Working Capital / Total Assets
	Current Assets / Total Assets
	Current Assets / Sales
	Inventory / Sales
	Sales / Working Capital
	Cost of Goods Sold / Inventory
Financial Leverage	Debt / Plant
	Debt / Total Capital
	Total Liability / Net Worth
	Total Assets / Net Worth
	Debt / Total Assets
	Total Liabilities / Total Assets
Receivables Intensiveness	Receivables / Inventory
	Inventory / Current Assets
	Inventory / Working Capital
	Receivables / Sales
	Quick Assets / Sales
Short Term Liquidity	Current Liabilities / Net Worth
	Current Assets / Current Liabilities
	Inventory / Working Capital
	Quick Assets / Current Liability
	Current Assets / Total Assets
Cash Position	Cash / Total Assets
	Cash / Current Liabilities
	Cash / Sales
	Quick Assets / Fund Expenditures
	Cash / Fund Expenditures

Table 2.

Another finding from Table 3 is the occurrence of trends in the classifications. The trends represent the behavior of the factor loadings with respect to the first through third periods. A downward trend indicates the factor loadings decreased each period within a classification. This trend would be considered widespread if the factor loading for the summary period correlated highly with the factor loadings from the other three periods. The analysis concluded Return on Investment and Cash Position experienced very widespread downward trends with Financial Leverage behaving the same but upward. Receivables Intensiveness had a moderately widespread upward trend while Capital Intensiveness was also upward but very unstable. The remaining two Inventory Intensiveness and Short Term Liquidity had little overall trend. The study concluded the classification categories were reasonably stable over a long period of time. [Ref. 1]

	Factors						
Years	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1951-1957	.973	.807	.650	.985	.938	.964	.941
1957-1963	.946	.808	.972	.987	.947	.951	.913
1963-1969	.928	.931	.970	.969	.930	.944	.872
1951-1969	.937	.800	.678	.983	.922	.937	.866

Table 3.

b. Pinches, Eubank, Mingo and Caruthers

The previous study was followed by another study by Pinches, Eubank, Mingo and Caruthers [Ref. 2] covering the years 1966, 1967, 1968 and 1969. The purpose of this study was to examine the short term stability of the empirical classifications of financial ratios in contrast to the long term study done previously. The same two hundred twenty-one firms and forty-eight financial ratios were observed for the years mentioned above. Factor analysis was employed again to determine the empirically based groupings of the financial ratios. Factor analysis yielded correlation coefficients for each of the ratios. These correlations between the ratios and the underlying factors are termed factor loadings. The

loading of these factors grouped into seven categories. These seven categories were given labels to represent the predominant meaning of the ratios that made up each classification. They are: (1) Return on Investment; (2) Capital Turnover; (3) Inventory Turnover; (4) Financial Leverage; (5) Receivables Turnover; (6) Short Term Liquidity and (7) Cash Position. These classification results matched the previous research done by Pinches, Mingo and Caruthers [Ref. 1].

The validation of the seven classifications was only part of the studies' findings. Further analysis was then conducted on the factor loadings of the financial ratios which made up the seven classifications. The factor loading during the analysis was set to reject ratios with a factor loading of less than (0.70). As a result, there were eight ratios that did not group into any of the seven classifications. They were: (1) Current Liabilities/Net Plant; (2) Working Capital /Total Assets; (3) Quick Assets/Fund Expenditures; (4) Cash Flow/Total Liabilities; (5) Net Income/Total Liabilities; (6) Fixed Charges/EBIT, (7) (Sales-Cost of Goods Sold)/Sales and (8) Net Income/Sales. Although these ratios did not load very high there could have been a correlation which existed. Therefore, further factor analysis was conducted with these eight ratios to determine if they would group into any of the classifications. The results of the analysis concluded none of the eight ratios regrouped into a previously determined classification. This finding is pertinent because it suggests there is a contradiction with traditional financial theory. The analysis did not have any groupings that would suggest there should be a separate profit margin factor. The Net Income/Sales ratio listed in Table 1 under the traditional category as a Profit Ratio was one of the ratios that did not group with any of the seven empirically suggested classifications. It tended to split between the classifications of Return on Investment and Capital Turnover. Furthermore, EBIT/Sales and Total Income/Sales, which are sometimes representative of profit, grouped into the Return on Investment classification. While the related ratio, Cash Flow/Sales, grouped into Capital Turnover classification. These results suggested that the concept of profit margin is not distinguishable between its components and may not represent a dimension of financial condition [Ref. 2]. The other seven ratios were not listed in any of the traditional financial categories. However, the study proposed the failure of the ratios to

group into a classifications suggests the firm's activities can be adequately measured by other financial ratios which do group into specific classifications, or they measure a unique characteristic of a firm's activities.

The next analysis conducted in this study was to focus on the stability of the classifications. To do this, factor analysis was conducted with the data correlated into a matrix for each of the following time periods: 1966-1967, 1967-1968, 1968-1969, 1966-69, the average of 1966-1968 and 1969. This process yielded correlation coefficients for each time period. The results from this analysis concluded that the classifications were not a unique or random occurrence. However, the analysis did reveal instability in Cash Position. The most important finding from the analysis was the correlation between the classifications. The study referred to these as higher order classifications, since they were based on the seven classifications previously determined. The first finding showed a correlation between Inventory Turnover and Receivables Turnover. Together, these two were labeled as Short Term Capital Turnover. This higher-order group appears to encompass financial ratios that measure short term purchasing and collection activities of industrial firms. However, turnover ratios measuring the longer-term aspects of a firm's operations, which appeared in the first-order group appear to encompass financial ratios that depict the asset (or liability) composition characteristics of industrial firms. The final finding showed a correlation between Return on Investment and Financial Leverage, which were combined and labeled Return on Invested Capital. This supports a relationship of a firm's return on investment and its use of financial leverage. [Ref. 2]

This study showed the functional similarity of various financial ratios by identifying those ratios which are in the same empirically determined classification [Ref. 2]. The seven ratio classifications and the two individual ratios most strongly associated with each category are summarized in Table 4 [Ref. 2]. An analyst may, therefore, be selective in choosing financial ratios that measure unique aspects of a firm's activities. By choosing the fewest financial ratios that represent the most information about a firms operation, more accurate decisions may be reached.

Classification:	Financial Ratio:
Return on Investment	Total Income / Total Capital Net Income / Net Worth
Capital Turnover	Sales / Net Plant Sales / Total Assets
Inventory Turnover	Inventory / Sales Cost of Goods Sold / Inventory
Financial Leverage	Debt / Total Capital Debt / Total Assets
Receivables Turnover	Receivables / Inventory Receivables / Sales
Short Term Liquidity	Current Assets / Current Liabilities Quick Assets / Current Liability
Cash Position	Cash / Total Assets Cash / Fund Expenditures

Table 4.

c. Chen and Shimerda

The studies [Ref. 1 and 2] discussed above suggest there are seven classifications of financial conditions that are relatively stable over both the long term and short term. The forty-eight financial ratios may also be significantly reduced to the ratios in Table 4 and still provide the analyst with the majority of information. The question then becomes whether these initial studies are limited due to the restricted data set. A study by Chen and Shimerda [Ref. 3] analyzed these studies and others to further investigate which financial ratios would be best for obtaining the information desired from the seven categories. The study examined thirty-four financial ratios that had been found in recent studies to be useful for predicting firm failure. The seven categories from the Pinches, Mingo and Caruthers [Ref. 1] and the Pinches, Eubank, Mingo and Caruthers [Ref. 2] were used as the factor space. Of the thirty-four ratios, there were ten that were not part of either one of these cases [Ref. 1 and 2], thus were not classified. These ratios are listed in Table 5 [Ref. 5] under the "Unclassified" column. Therefore, factor analysis, specifically component analysis, was performed to study the relationship of the ten unclassified ratios to the seven categories.

A sample set of one thousand fifty-three firms with complete financial data for 1977 was used. The results of this component analysis enabled the ten unclassified ratios to be correlated with ratios that were identified in the Pinches, Mingo and Caruthers [Ref. 1] and the Pinches, Eubank, Mingo and Caruthers [Ref. 2] studies. The ratios which they correlated with are listed in Table 5 under the "Classified" column. According to Chen and Shimerda [Ref. 3] the conclusions reached from their study is that financial ratios useful for predicting firm failure can be grouped into the seven classification framework, and significantly reduced to fewer ratios. The reduction is possible because the differences in the ratios are more of a terminology issue rather than an information issue. Most of the information can be retained by a careful selection of fewer ratios. However, the study did conclude the high correlation between ratios is sample sensitive and can often be misleading. Because of this Chen and Shimerda [Ref. 3] stated that the methods used may be satisfactory for data reduction, but not for model building or theory construction [Ref. 3].

Classification:	Unclassified:	Classified:
Return on Investment	Net Income / Sales	EBIT / Sales
	Net Income / Common Equity	Net Income / Net Worth
Capital Turnover	Working Capital / Total Assets	Current Assets / Total Assets
Financial Leverage	Funds Flow / Total Debt	Net Worth / Total Debt
	Funds Flow / Current Liabilities	Net Worth / Total Debt
	Long-Term Debt / Current Assets	Long-Term Debt / Total Assets
	Retained Earnings / Total Assets	Total Debt / Total Assets
Receivables Turnover	Quick Assets / Inventory	Receivables / Inventory
Cash Position	No Credit Interval	Cash / Sales
	Quick Flow	Cash / Sales

Table 5.

d. Ketz, Doogar and Jensen

The final study to be reviewed was conducted by Ketz, Doogar and Jensen [Ref. 4]. The purpose of this study was to examine the comparability of financial ratios across seven industries by assessing the similarity or dissimilarity among the empirical

classifications unique to each industry. The financial data from four hundred seventy-six firms during the time period from 1978 to 1987 was compiled to construct thirty- two financial ratios. The four hundred seventy-six firms were then grouped into seven industries. They are: (1) automobile and aerospace; (2) chemical, rubber, and oil; (3) electronic; (4) food; (5) retail; (6) steel; and (7) textile. Industries were based on the Standard Industrial Classification code, which is designated to the firm when it is incorporated. Factor analysis was employed again in this study to examine the correlation of the thirty-two ratios within each industry. The results yielded the familiar seven groupings discovered in the Pinches, Mingo and Caruthers [Ref. 1] and the Pinches, Eubank, Mingo and Caruthers [Ref. 2] studies. They were: (1) Return; (2) Cash Flow; (3) Cash Position; (4) Inventory; (5) Sales; (6) Liquidity; and (7) Debt. The ratios which make up these classifications are listed in Table 6 [Ref. 4]. The conclusion to be made from this study is that the same empirical classifications exist in separate industries. The labels associated with the groupings may differ in this study, but the same fundamental empirical classifications still remain. The only exception is the Retail Industry in which Return can be further broken down into two factors. The Return on Sales factor consists of operating income/sales, operating income plus depreciation/sales, and working capital from operations/sales. The Return on Assets factor is comprised of operating income /total assets, operating income/total debts, operation income plus depreciation/total assets, operating income plus depreciation/total debts, working capital from operations/total assets, and working capital from operations/total debts. [Ref. 4]

Classification:	Financial Ratio:
Return	Operating Income/Sales
	Operating Income/Total Assets
	Operating Income + Depreciation/Sales
	Operating Income + Depreciation/Total Assets
	Operating Income + Depreciation/Total Debts
	Working Capital from Operations/Sales
	Working Capital from Operations/Total Assets
	Working Capital from Operations/Total Debts
Cash Flow	Cash from Operations/Sales
	Cash from Operations/Total Assets
	Cash from Operations/Total Debts
Cash Position	Cash/Current Debts
	Cash/Sales
	Cash/Total Assets
	Cash/Total Debts
Inventory	Cost of Goods/Inventory
	Inventory/Current Assets
	Inventory/Sales
	Receivables/Inventory
Sales	Current Assets/Sales
	Receivables/Sales
	Sales/Receivables
	Sales/Total Assets
Liquidity	Current Assets/Current Debts
	Quick Assets/Current Debts
Debt	Current Debts/Total Debts
	Long-Term Debts/Total Assets
	Total Debts/Total Assets

Table 6.

D. SUMMARY OF FINDINGS

Financial ratio analysis continues to be a popular tool used for analyzing many aspects of a firm. According to Ketz, Doogar and Jensen [Ref. 4] the popularity of financial ratios attest to their perceived utility when making financial decision. The studies reviewed previously describe the many dimensions of financial condition involved in financial ratio analysis. The most prevailing finding repeatedly supported is the classification of seven groupings of financial ratios [Ref. 1, 2, 3 and 4]. This is of significance because these classifications can summarize the meaning of large amounts of financial information for better use by the decision maker. Since the ratios that grouped to one of the seven classifications are empirically linked to that category, they can then be used to reflect that

condition. These classifications also allow the reduction of data by using fewer, but more representative financial ratios [Ref. 2 and 3]. This result is notable because it allows the decision makers to process less information. A final finding revealed by the studies [Ref. 1,2,3, and 4] in financial ratio analysis is that the dimensions of financial conditions represented by these classification are stable over time. The classifications are considered stable if the information the classification represents is highly correlated from year to year. The study by Pinches, Mingo and Caruthers [Ref. 1] suggested Financial Leverage was the most stable, while Capital Intensiveness and Receivables Intensiveness were the least stable. All of these findings are of particular importance when conducting analysis with financial ratios. They will be taken into consideration for the remaining chapters of this thesis.

III. METHODOLOGY

A. OBJECTIVES

The objective of this chapter is to discuss the methodology that will be used to perform the analysis and answer the research questions of this thesis. The first step will be to identify the sample and the data items. The second step will be to select the financial ratios to be used. The third step will be to distinguish some measures of changes in the ratios. The final step of the methodology will be a discussion of the structure of analysis designed to answer the research questions.

B. SAMPLE

1. Firms

The sample for this study was a selection of defense industry firms. Before selecting the firms a time period had to be identified so limits could be set on the information to be analyzed. The time period selected was from 1983 to 1992. This period is significant because it is current and is representative of a time period when changes in the industry occurred. The changes in the defense industry were primarily affected by a fluctuating economy and a decrease in defense spending. The firms selected for the sample set were chosen from among the top one hundred defense contractors to the U.S. Government for 1993 [Ref. 9]. The fifty firms selected are listed in Table 7. The selection for the fifty firms was based on two criteria, size and diversity. The size criteria enabled the selection of the largest firms based on total assets and net contractor value. The second criteria enabled the selection of a diversity of firms by choosing firms that competed in the most sub-industries of the defense industry. These eight sub-industries are: (1)Ships, (2)Tanks and Automotive, (3)Aircraft, (4)Missiles, (5)Training Systems and Services, (6)Automatic Data Processing, (7)Electronics and Communications and (8)Strategic Defense Initiatives.

Selected Defense Industry Firms

Allied Signal
AT&T
Black and Decker
Boeing
Chrysler
Coastal
Computer Science Corporation
Control Data
CSX
Dynamics
E - Systems
Eastman Kodak
Eaton Corp.
EG&G
FMC
Ford Motor
Gencorp
General Dynamics
General Electric
General Motor
Grumman
GTE
Harris
Harsco
Hercules
Hewlett Packard
Honeywell
IBM
ITT
Johnson Controls
Kaman
Lockheed
Loral
LTV
Martin Marietta
McDonnell Douglas
Motorola
Morrison Knudsen
Northrop
Olin
Raytheon
Rockwell International
Teledyne
Texas Instruments
Trinity
TRW
Unisys
United Industries
United Technologies
Westinghouse Electric

Table 7.

Selected Financial Information

BALANCE SHEET ITEMS
- Cash and Marketable Securities
- Receivables
- Inventory
- Total current assets
- Net plant, property, and equipment (fixed assets)
- Total assets
- Accounts payable and accrued expenses
- Total current liabilities
- Long term debt
- Other long term liabilities
- Total liabilities
- Preferred stock
- Retained earnings
- Total stockholder's equity

INCOME STATEMENT ITEMS
- Net sales
- Cost of goods sold (COGS)
- Total operating expenses
- Net operating income
- Interest expense
- Income tax expense
- "Total" income from continuing operations
- Net Income
- Earnings per share from continuing operations
- Earnings per share from discontinuing operations

CASH FLOW STATEMENT
- Cash flow from operations
- Working capital from operations
- Net capital expenditures
- Depreciation, amortization, and depletion

ADDITIONAL DATA ITEMS
- Total revenue from government
- Year

Table 8.

2. Data Items

Once the firms were selected, financial information was collected from each firm. This information was obtained from the firm's financial statements, company 10K reports filed with the Securities Exchange Commission, or Moody's industrial manuals. The specific financial information selected consisted of the thirty items listed in Table 8. The thirty items selected were chosen so the necessary information would be available to construct a large number of ratios which will be discussed in the next section. The information was collected for each year from 1983 to 1992.

C. FINANCIAL RATIO SELECTION

As described in Chapter II there are many ratios available to provide financial condition information to the decision maker. The objective of this study is to identify the primary dimensions of change in the financial condition of defense industry firms. These dimensions of change are going to be evaluated by examining interrelationships of the financial ratios. To properly evaluate these interrelationships as much financial information needs to be represented as feasible. This will be achieved by using the data items in Table 8 to construct various financial ratios.

1. Dimensions of Financial Conditions

The dimensions of financial conditions to be used for this study will be based on the findings reviewed in Chapter II. The dimensions of financial condition are often defined by groupings of financial ratios which are given category labels. From the literature review there were seven empirical classifications prevalent in each of the four studies [Ref. 1,2,3 and 4]. In order to examine the primary dimensions of change in financial conditions for the selected defense industry firms the seven category framework will be used. The labels used by Pinches, Eubank, Mingo and Caruthers [Ref. 2] for the seven categories will be the basis for identifying the dimensions. They are: (1) Return on Investment; (2) Capital Turnover; (3) Inventory Turnover; (4) Financial Leverage; (5) Receivables Turnover; (6) Short Term Liquidity and (7) Cash Position. These categories will then be represented by specific financial ratios that have been empirically linked to these dimensions by the previous studies.

The first two ratios for each category in this study will come from those listed in Table 4. The ratios in Table 4 are Pinches, Eubank, Mingo and Caruthers [Ref. 2] most representative ratios of the seven categories in their study. The additional ratios selected for each category are from Table 2 and Table 6. They will maintain the category they were represented in from their associated study. A description of the categories and the selected ratios used to represent them is described in the next section.

2. Category Description and Selected Ratios

a. Return on Investment

The return on investment category can be defined as the relationship between profitability and investment [Ref. 10]. It provides measures of the defense industry firms with regards to management's operating and financial success. Ratios to be used for measuring this are:

Total Income / Total Capital
Net Income / Net Worth
Total Income / Sales
Cash Flow / Total Assets
Cash Flow / Net Worth
Total Income / Total Assets
Net Income / Total Assets
Cash Flow / Total Capital

b. Turnover

This classification consist of the Capital, Inventory and Receivables turnover ratios. Ratios in these categories are used to measure the efficiency of outputs to inputs. These measures enable an evaluation to be made of how well the defense industry firms are using resources. Ratios to be used are:

(1) Capital Turnover.

Sales / Net Plant
Sales / Total Assets
Cash Flow / Sales
Net Income / Sales
Sales / Total Capital

(2) Inventory Turnover.

Inventory / Sales
Cost of Goods Sold / Inventory
Working Capital / Total Assets
Current Assets / Sales
Sales / Working Capital

(3) Receivables Turnover.

Receivables / Inventory
Receivables / Sales
Inventory / Current Assets
Quick Assets / Sales

c. Financial Leverage

The financial leverage category refers to a defense industry firm's use of capital secured from creditors. Creditor financing is typically undertaken with the hope to produce a return greater than that needed to cover interest on the related liability. [Ref. 6] The ratios associated with this category are measuring financial risk of the firm's capital structure. Ratios to be used for measuring this are:

Debt / Total Capital
Debt / Total Assets
Total Liability / Net Worth
Total Assets / Net Worth

d. Short Term Liquidity

The short term liquidity category measures the defense industry firm's ability to meet its short term obligations as they mature [Ref. 6]. This is accomplished by measuring the ability of the firm to raise cash from all of its sources to pay its debt. Ratios to be used for measuring this are:

Current Assets / Current Liabilities
Quick Assets / Current Liabilities
Current Liabilities / Net Worth
Inventory / Working Capital
Current Assets / Total Assets

e. Cash Position

The cash position classification measures the defense industry firm's position with respect to the most liquid asset, cash. Ratios to be used for measuring this are:

Cash / Total Assets
Cash / Fund Expenditure
Cash / Sales
Cash / Current Liabilities
Quick Assets / Fund Expenditures

D. MEASURES OF CHANGE

The objective of this thesis is to identify the primary dimensions of change in financial conditions of defense industry firms. Now that the firms have been identified and the dimensions of financial condition can be measured by specific ratios, a measure of change in ratio values is necessary. Two methods will be used to calculate measures of change of ratios. Both methods will be applied to each of the ratios selected in the previous section.

1. Absolute Change

Absolute change measures the difference of two given values. For this study the absolute change will be calculated as the difference between a ratio's value (R) from one time period (t-1) to a later time period (t). The time period consist of one year to the next. The calculation will be represented as follows:

$$\text{Ratio absolute } \Delta = \{R_t - R_{t-1}\}$$

For simplicity this measure of change will be referred to as the ACHG (Absolute Change).

2. Percent Change

Percent change measures the difference of two given values and expresses that change in a percentage (%) format. For this study the percent change will be calculated as difference between a ratio's value (R) at the measured time (t) and the ratio's value (R) at an earlier time period (t-1), divided by the ratio's value (R) at the earlier time period (t-1). The time period consist of one year to the next. The calculation will be represented as follows:

$$\text{Ratio \% } \Delta = \{R_t - R_{t-1}\} \; / \; R_{t-1}$$

For simplicity this measure of change will be referred to as the PCHG (Percent Change).

E. STRUCTURE OF ANALYSIS

The previous sections have identified the ratios to be used in the analysis, and the methods to be used for measuring changes in those ratios. The next step is to discuss how these measures will be analyzed in conducting the investigation. The following sections outline the research questions addressed and the structure of the analysis to answer those questions.

1. Primary Dimensions of Change

To begin the analysis the primary research question (PRQ) will be addressed. What are the primary dimensions of change in the financial conditions of defense industry firms? However, before this question is analyzed, the categories and their ratios selected above will be verified to have an empirical link to one another. This will be done by a factor analysis procedure. If there is an existence of ratio correlations among the respective categories chosen, this will support the seven category framework discussed in Chapter II. The procedure will be conducted as one combined data set of all thirty-six ratios of each firm for all ten years. This will be referred to as the "pooled" data set.

Once the framework is examined for this study's sample set, the remaining analysis will be conducted to answer the PRQ. This analysis will consist of using factor analysis techniques to identify interrelationships and correlations between the change measures (ACHG, PCHG). The changes will be calculated for the thirty-six ratios of each firm for all ten years. This will yield nine yearly measures of change for each ratio. Factor analysis will then be conducted on these nine measures as a pooled data set in order to determine which changes are most highly correlated with each other for all ten years. The identification of correlations between changes from the pooled data set will provide the information needed to answer the PRQ. Additionally, this analysis will provide the information needed to answer SRQ 3 and SRQ 5.

2. Stability of the Dimensions of Change

The next step will be to examine the stability of the dimensions of change identified in the previous analysis and provide the information necessary to answer SRQ 1. The same method will be conducted as above, however, the nine yearly measures of change will not be pooled together into one data set. Factor analysis will be conducted on the yearly changes separately (1983-1984, 1984-1985, etc.). These will be referred to as an "annual" data set. The results from this analysis will identify the correlations of changes for each year. If the correlations of changes are the same from year to year, then stability would exist among the dimensions of change. This analysis will additionally provide answers to SRQ 3 and SRQ 4.

3. Periods of Economic Growth and Decline

The final step will be to incorporate the effects of periods of economic growth and decline on the analysis, thereby providing the answer to SRQ 2. To conduct this analysis the years covered in the sample will be separated into two pools. The early years 1983 through 1986 will represent the "growth" data set and the later years from 1987 through 1992 will represent the "decline" data set. A historical look at economic indicators will support these groupings as periods of growth and decline. Factor analysis will then be conducted on these as two separate data sets. The identification of correlations between changes from both data sets will provide the information needed to answer SRQ 2. The analysis will also provide answers toe the related SRQ 3 and SRQ 4.

IV. ANALYSIS

A. OBJECTIVES

The objective of this chapter is to present the results of the analysis performed to answer the Primary Research Question (PRQ) and the Subsidiary Research Questions (SRQ) of this thesis. The results presented will be described as outlined in Section E of Chapter III. The section will consist of the interpretations of the results with Tables of the actual data that was analyzed. The final step of the analysis will be a review of the implications.

B. FACTOR ANALYSIS RESULTS

The factor analysis results for the following sections were attained by using the FACTOR procedure in the SAS system. The FACTOR procedure performs a variety of common factor, component analyses and rotations. The results from the rotated primary factor pattern will be used for the following sections. Specifically the orthogonal transformation will be used. The rotation methods all yield equally good statistical information, however, they differ in the manner in which they can be interpreted. The results from the following analyses were best interpreted by using the orthogonal transformation. [Ref. 10]

1. Verifying Dimensions of Financial Condition

The factor analysis results conducted to verify the seven category framework are shown in Table 9. As described in Chapter III, this analysis was conducted on the pooled data set of all ten years for each of the thirty-six ratios. The numbers in Table 9 are the factor loadings. These represent the correlations that exist between the ratio and the factors at the top of Table 9. For interpretation purposes, the only factor loadings listed in Table 9 are the individual ratio's highest loadings from the factor analysis procedure. These ratios are also listed by the categories they were assigned in Chapter III.

The data in Table 9 indicate obvious correlations for the Return on Investment category and the Cash Position category. All of the ratios selected for the Return on Investment category had their highest loadings only in Factor 1. Therefore, Factor 1 clearly

seems to be the "Return on Investment" factor. The ratios selected for Cash Position, with the exception of one (Quick Assets / Fund Expenditure), all had their highest loadings in Factor 3, hence Factor 3 seems to be a "Cash Position" factor.

The remaining factors from this analysis are not as obvious as the Return on Investment and Cash Position factors. Therefore, the remaining factors will be assigned labels based on observations of the financial information contained in the ratios that loaded highly for the individual factors. The ratios contained in Factor 2 include Total Assets as a common element. This seems to be the only element which differentiates this factor. Consequently, the label "Total Assets" will represent Factor 2. The ratios which make up Factor 4 contain information with respect to Net Worth. These types of ratios are commonly indicative of a firm's use of financial leverage. The label "Leverage" will be used to represent Factor 4. The ratios which are contained in Factor 5 predominantly consider financial information that represent a relationship of assets to sales. This is used to indicate a firms receivables turnover, hence Factor 5 will be labeled "Receivables Turnover" factor. The ratios contained in Factor 6 all include Inventory as a common element and will be referred to as the "Inventory" factor. Factor 7 has relatively few ratios in it. The highest factor loading occurs for the Current Assets / Current Liabilities ratio which is most commonly associated with short term liquidity. The Quick Assets / Current Liabilities ratio is not as highly correlated but it is also considered a measure of short term liquidity. The most appropriate label would be the "Short Term Liquidity" factor. The remaining Factors 8 contains a single ratio which is used to refer to the amount of capital used by a firm. This will be labeled the "Capital Turnover" factor.

There is significant overlap that exists between the factors labeled above and the findings discussed in Chapter II from Pinches, Eubank, Mingo and Caruthers [Ref. 2]. Their findings supported a seven category framework, with two ratios representing each category. The first two ratios listed in each of the categories on Table 9 are those most representative ratios from the Pinches, Eubank, Mingo and Caruthers [Ref. 2] study. It would be beneficial to compare the overlap between the current finding of this study with the Pinches, Eubank, Mingo and Caruthers [Ref. 2] seven category framework.

The overlap for Factor 1, the "Return on Investment" factor and Factor 3, the "Cash Position" factor do not need to be discussed because allignment between the two studies on these two categories is so evident. The next overlap occurs in the Inventory Turnover category. The most representative ratios for this study are also Pinches, Eubank, Mingo and Caruthers [Ref. 2] most representative ratios for their study. The Financial Leverage category for this study did not support the Pinches, Eubank, Mingo and Caruthers [Ref. 2] most representative ratios because for this study the highest loadings were with Total Liability / Net Worth and Total Assets / Net Worth which both loaded high in Factor 4. The Pinches, Eubank, Mingo and Caruthers [Ref. 2] most representative ratios for Receivables Turnover split between 5 and Factor 6. The Capital Turnover category did not load high independently of other factors except for the Sales / Net Plant loading in Factor 8.

The objective for this section was to confirm, if supported by the evidence, the existence of the seven category framework in this study so that it may be referred to in the later analysis on the dimensions of change. The analysis confirms the identification of six of the seven categories. The Return on Investment and Cash Position category are most easily supported. This analysis does provide valuable information on which ratios fit more closely with which category.

Verifying Dimensions	Factor Loadings									
Financial Ratios	Factor1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor10
Return on Investment										
Total Income / Total Capital	0.8618									
Net Income / Net Worth	0.6325									
Total Income / Sales	0.8877									
Cash Flow / Total Assets	0.8069									
Cash Flow / Net Worth	0.6328									
Total Income / Total Assets	0.8965									
Net Income / Total Assets	0.9121									
Cash Flow / Total Capital	0.8542									
Capital Turnover										
Sales / Net Plant								0.8541		
Sales / Total Assets		0.8725								
Cash Flow / Sales	0.7921									
Net Income / Sales	0.8821									
Sales / Total Capital								0.6472		
Inventory Turnover										
Inventory / Sales						- 0.7902				
COGS / Inventory						0.8533				
Working Capital / Total Assets								0.6295		
Current Assets / Sales									0.8030	
Sales / Working Capital										0.6464
Receivables Turnover										
Receivables / Inventory						0.8203				
Receivables / Sales					0.9508					
Inventory / Current Assets						- 0.7821				
Quick Assets / Sales					0.9119					
Financial Leverage										
Debt / Total Capital							0.6115			
Debt / Total Assets		0.9444								
Total Liability / Net Worth				0.9318						
Total Assets / Net Worth				0.9381						
Short Term Liquidity										
Current Assets/Current Liabilities							0.8212			
Quick Assets / Current Liabilities							0.5491			
Current Liabilities / Net Worth				0.9104						
Inventory / Working Capital		- 0.9444								
Current Assets / Total Assets		0.8707								
Cash Position										
Cash / Total Assets			0.8846							
Cash / Fund Expenditure			0.8908							
Cash / Sales			0.8311							
Cash / Current Liabilities			0.8326							
Quick Assets / Fund Expenditures					0.9188					

Table 9.

2. Analysis of Primary Dimensions of Change

The analysis on the primary dimensions of change was conducted to answer the PRQ. This analysis consisted of using the two measures of change ACHG and PCHG described in Chapter III. The results of the analysis conducted to identify the correlations for ACHG on the pooled data set are listed in Table 10, and for PCHG on the pooled data set are listed in Table 11. Like in the previous analysis, the highest factor loadings for each of the thirty-six ratios are listed. However, for Table 10 and 11 these results represent the factor loadings when the factor analysis procedure was constrained to seven factors (NFACTORS=7). This was done to enable better interpretations of the results. The unconstrained factor analysis procedure was conducted and provided only minimal differences in the lower factor loadings.

a. ACHG Dimensions of Change

For analysis of the ACHG results in Table 10, the factor loadings and the associated ratios that did not correlate higher than ±0.70 will be disregarded. This is to ensure the interpretations can be regarded as significant. With this taken into consideration, the results from Table 10 suggest six groupings of ratios. These groupings may be representative of dimensions of change. They appear in Factor 1, 2, 4, 5, 6 and 7. The number of ratios which make up each of the groupings range from nine in Factor 1, six in Factor 2, six in Factor 4, four in Factor 5, only two in Factor 6 and one in Factor 7. The ratio's factor loading within each group can be arranged in a hierarchial order to signify the highest degree of association within the group. Furthermore, the factors can be contrasted with the seven category framework examined earlier to detect a relationship between the dimensions of financial conditions and these dimensions of change.

b. PCHG Dimensions of Change

The results in Table 11 are from the PCHG analysis. The same ±0.70 criterion will be applied to this analysis for interpretation purposes. The results from this analysis are somewhat similar to the results in Table 10. Table 11 also suggest six groups of ratios, but they are not made up of all the same ratios. These groups may also be representative of dimensions of change. They appear in Factor 1, 2, 3, 4, 5 and 6. The number of ratios

which make up each of the groups range from six in Factor 1, four in Factor 2, four in Factor 3, three in Factor 4, four in Factor 5 and two in Factor 6. Like above, the ratio's loadings within each group can be arranged in a hierarchial order to signify the highest degree of association within the group. These groups then can be contrasted with the seven category framework examined earlier to detect a relationship between the dimensions of financial conditions and these dimensions of change.

The results presented above suggest there are correlations among changes in ratios. However, not all the correlations are the same between the two measures of change. Further analysis of this observation will be conducted in the next section. Regardless, the number of ratios which make up the groupings is of particular significance. A large number of ratios grouping on a particular factor may indicate a significant dimension of change. Where as a single ratio that makes up a factor is nothing more than that ratio measuring its unique information. Therefore, the results above may only indicate five groupings for the ACHG measure and six for the PCHG measure. The assumption will be made that these are the preliminary dimensions of change for each respective measure. These dimensions of change for ACHG will be labeled "A"through "E" and the dimensions of change for PCHG will be labeled "A" through "F" so they may be referred in the following analysis.

Pooled Data Set	Factor Loadings						
ACHG of Financial Ratios	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Return on Investment	A						
Total Income / Total Capital	0.8317						
Net Income / Net Worth	0.6458						
Total Income / Sales	0.9023						
Cash Flow / Total Assets	0.8245						
Cash Flow / Net Worth	0.7360						
Total Income / Total Assets	0.8949						
Net Income / Total Assets	0.9350						
Cash Flow / Total Capital	0.9141						
Capital Turnover							
Sales / Net Plant		B				0.5343	
Sales / Total Assets		0.9554					
Cash Flow / Sales	0.8958						
Net Income / Sales	0.9195						
Sales / Total Capital		-0.7035					
Inventory Turnover						E	
Inventory / Sales						-0.7717	
COGS / Inventory						0.7563	
Working Capital / Total Assets							0.5622
Current Assets / Sales			0.6285				
Sales / Working Capital					-0.0709		
Receivables Turnover							
Receivables / Inventory				C		0.5998	
Receivables / Sales				0.7461			
Inventory / Current Assets			-0.5626				
Quick Assets / Sales				0.9057			
Financial Leverage							
Debt / Total Capital		-0.7131					
Debt / Total Assets		0.9773			D		
Total Liability / Net Worth					0.9586		
Total Assets / Net Worth					0.9536		
Short Term Liquidity							
Current Assets / Current Liabilities							0.7157
Quick Assets / Current Liabilities				0.7537			
Current Liabilities / Net Worth					0.9558		
Inventory / Working Capital		-0.9676					
Current Assets / Total Assets		0.9505					
Cash Position							
Cash / Total Assets				0.7757			
Cash / Fund Expenditure				0.9208			
Cash / Sales				0.9164			
Cash / Current Liabilities				0.6963			
Quick Assets / Fund Expenditures					0.8854		

Table 10.

Pooled Data Set	Factor Loadings						
PCHG of Financial Ratios	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Return on Investment	A						
Total Income / Total Capital	0.9547						
Net Income / Net Worth	0.9663						
Total Income / Sales	0.9658				E		
Cash Flow / Total Assets					0.9954		
Cash Flow / Net Worth					0.9800		
Total Income / Total Assets	0.9640						
Net Income / Total Assets	0.9463						
Cash Flow / Total Capital					0.9944		
Capital Turnover							
Sales / Net Plant						0.5583	
Sales / Total Assets						0.9497	
Cash Flow / Sales					0.9895		
Net Income / Sales	0.9472						
Sales / Total Capital						0.9173	
Inventory Turnover				D		F	
Inventory / Sales				0.9072			
COGS / Inventory						0.4340	
Working Capital / Total Assets						-0.2327	
Current Assets / Sales						-0.6103	
Sales / Working Capital							-0.6683
Receivables Turnover							
Receivables / Inventory		0.4068					
Receivables / Sales				0.8736			
Inventory / Current Assets				0.8470			
Quick Assets / Sales				0.6359			
Financial Leverage		B					
Debt / Total Capital		0.8909					
Debt / Total Assets		0.8560					
Total Liability / Net Worth		0.9002					
Total Assets / Net Worth						-0.4003	
Short Term Liquidity							
Current Assets / Current Liabilities							0.5693
Quick Assets / Current Liabilities							0.6356
Current Liabilities / Net Worth		0.9248					
Inventory / Working Capital							-0.6753
Current Assets / Total Assets				0.6224			
Cash Position			C				
Cash / Total Assets			0.9723				
Cash / Fund Expenditure			0.9820				
Cash / Sales			0.9774				
Cash / Current Liabilities			0.9662				
Quick Assets / Fund Expenditures				0.5578			

Table 11.

3. Stability of the Dimensions of Change

The analysis of the stability of the dimensions of change was conducted to answer SRQ 1 as described in Chapter III. Factor analysis was conducted separately for each one year increment (1983-1984, 1984-1985 etc.) as an annual data set for both measures of change. The number of factors was constrained to seven to keep the technique consistent with the previous analysis. The highest factor loadings for each ratio were then identified and groupings of ratios were identified with single factors. The analysis then consisted of making visual comparisons of the overlap between the groups of ratios from the annual data set results with the groups of ratios which made up the preliminary dimensions of change identified in the previous ten year pooled analysis.

The degree of overlap was evaluated to fall under one of three categories for each annual data set. The first was if the all the ratios matched exactly in an occurence (designated by ✔ in Tables 12 and 13). This means all the ratios in a group in the annual analysis matched the ratios that occurred in the previous defined groups in the pooled analysis. The second was if there was a partial match. This was when there was at least a 70% overlap of the ratios (designated by * in Tables 12 and 13). For example, if a dimension of change was made up of four ratios and an annual data set had a group that consisted of three of these four ratios, then a partial match would occur. The third category was when there was no reasonable match, which was when less than 70% of the ratios matched (designated by ✘ in Tables 12 and 13).

a. Stability with ACHG

The analysis of stability with ACHG using the criteria described above are summarized in Table 12. Overall, these results are mixed. The "A" dimensions of change had a split between partial matches and exact matches. This suggest the ratios that make up this group are stable greater than 70% of the time. The ratios which make up the "C" and "D" dimensions of change for ACHG had totals predominantly in the partial match category. The partial match category represents a match of at least 70% of the total ratios. (To properly evaluate the stability of these dimensions the overlap would need to be evaluated again to find which ratios consistently did occur.) The ratios which made up the "B" and "E"

dimensions of change had very few matches. A possible reason for the inconsistency observed in this analysis is due to the measure of change being used. The ACHG measure does not standardize the data. This could lead to conflict when trying to make comparisons between a pooled data set of years with single year increments. The PCHG measure does standardize the measure and this method was used in the following analysis.

ACHG Annual Data Sets vs. Preliminary Dimensions of Change					
Years	A	B	C	D	E
83-84	*	✔	✘	✔	✔
84-85	✔	✘	*	*	✘
85-86	✔	✘	*	*	✘
86-87	*	✘	*	*	✘
87-88	*	✘	*	✘	✘
88-89	✔	✘	*	*	✘
89-90	✔	✘	*	*	✘
90-91	*	*	*	*	*
91-92	*	✘	*	*	*
Totals	4✔ 5*	1✔ 7✘ 1*	1✘ 8*	1✔ 1✘ 7*	1✔ 6✘ 2*

Table 12.

b. Stability with PCHG

The analysis conducted while using the PCHG measure clearly provided more interpretable results. These are summarized in Table 13. The "B" and "C" dimensions of change had exact matches for all nine of the annual data sets. The ratios which make up these dimensions of change occur regardless of whether the yearly data is pooled together or analyzed as separate annual data sets. This suggests these dimensions are stable. The "A" and "E" dimensions of change did not have exact matches with every annual data set. However, seven of nine exact matches occurred for "E" and five of nine exact matches for "A" suggest these dimensions do occur the majority of the time. This suggests that the "A" and "E" dimensions of change exist but may not be as stable as the "B" and "C" dimensions

of change. The results from the "D" and "F" dimensions of change are unclear. Exact matches did not occur and this suggests these dimensions may not be stable. The "D" dimension of change had a significant number of partial matches. The individual ratios for this dimension of change would need to be evaluated to determine which ratios consistently occurred. Since the "F" dimension of change only consisted of two ratios and these did not occur consistently, this suggests this dimension of change is not stable and may not actually exist.

The results from this analysis suggest that dimensions of change are more stable when measured by PCHG. This may be attributed to the measure's ability to standardize the data. Therefore, the PCHG will be the measure of change used for the remainder of the analysis.

PCHG Annual Data Sets vs. Preliminary Dimensions of Change						
Years	A	B	C	D	E	F
83-84	✘	✔	✔	✔	✘	✘
84-85	✔	✔	✔	✘	✔	✔
85-86	✘	✔	✔	✘	✔	✘
86-87	✔	✔	✔	✘	✔	✘
87-88	✘	✔	✔	*	✘	✘
88-89	✔	✔	✔	*	✔	✘
89-90	✘	✔	✔	*	✔	✘
90-91	✔	✔	✔	✘	✔	✘
91-92	✔	✔	✔	*	✔	✘
Totals	5✔ 4✘	9✔	9✔	1✔ 4✘ 4*	7✔ 2✘	1✔ 8✘

Table 13.

4. Periods of Economic Growth and Decline

The analysis of the separate periods of economic growth and decline was conducted to answer SRQ 2 as described in Chapter III. The results of the analysis for the growth data set are listed in Table 14, and the results for the decline data set are listed in Table 15. The number of factors was constrained to seven to keep the technique consistent with the previous

analysis. The highest factor loadings for each ratio were then identified and groups of ratios were identified with single factors. The only factor loadings that were considered were those that were higher than ±0.70. The only measure of change used for this analysis was PCHG.

a. Growth

Four observations concerning the growth period are noteworthy. First, the results listed in Table 14 for the growth data set meet the exact match criteria established in the previous analysis for the "A" through "F" dimensions of change. Second, the factor loadings that correspond to dimension of change "A" for the growth data set all correlated slightly higher. The factor loadings that correspond to dimension of change "C" and "F" for the growth data set all correlated slightly lower. This suggests that the ratios within the "A" dimension of change are more highly correlated for the growth data set than the pooled data set. The reverse is true for the "C" and "F" dimensions of change. Third, the "B" and "D" dimensions of change both had other ratios join their groupings. The ratios that joined "B" were previously uncorrelated with any other group. The ratio that joined "D" resulted from a higher factor loadings for the individual ratios. This suggest that these two dimensions may be defined by more ratios when the data set is limited to years of economic growth. Fourth, the data in Table 14 also indicates there may be other dimensions of change that did not appear in the pooled data but now appear in the growth data set. These ratios appear in Factor 7 and suggest an additional dimension of change may occur.

b. Decline

Four observations concerning the decline period are noteworthy. First, the results listed in Table 15 for the decline data set meet the exact match criteria established in the previous analysis for the "A", "B", "C" and "E" dimensions of change. The "D" dimension of change was a partial match and the "F" dimension of change did not appear to occur. Second, the factor loadings that correspond to dimension of change "A" for the decline data set all correlated slightly higher. The factor loadings that correspond to dimension of change "C" for the growth data set all correlated slightly lower. This suggests "A" dimension of change are more highly correlated for the decline data set than the pooled data set. The reverse is true for the "C" dimensions of change. Third, the "B" dimension of

change had other ratios join its grouping. The ratios that joined "B" were previously uncorrelated with any other group. This suggests that this dimension may be defined by more ratios during periods of economic decline. The partial match for the "D" dimension of change and the addition of other ratios indicates the ratios that make up this dimension are less consistent during periods of economic decline. The failure of "F" to occur may indicate this dimension is not stable during economic decline or that it does not exist. The data in Table 15 also indicates there may be other dimensions of change that did not appear in the pooled data but now appear in the decline data set. These ratios appear in Factor 6 and 7 suggesting additional dimension of change may occur for this data set.

c. Growth versus Decline

Perhaps the most beneficial observations for this analysis were made by comparing the growth versus decline data sets with each other. There were three notable observations. First, the "A", "C" and "E" dimensions of change contained the exact same ratios for both growth and decline. This suggests these dimensions of change are consistent regardless of economic conditions. The second observation was the "B" dimension of change contained four consistent ratios out of seven ratios between the growth and decline data set. The "D" dimension of change contained five consistent ratios of ten ratios between the growth and decline data set. This suggests that particular ratios best representing the "B" and "D" dimensions of change are not stable across of economic growth and decline. Third, the "F" dimension of change only appeared in the growth data set, which suggest this dimension of change is only consistent during periods of economic growth.

Growth Data Set	Factor Loadings						
PCHG of Financial Ratios	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Return on Investment	A						
Total Income / Total Capital	-0.9828						
Net Income / Net Worth	0.9907						
Total Income / Sales	-0.9828				E		
Cash Flow / Total Assets					0.9907		
Cash Flow / Net Worth					0.9814		
Total Income / Total Assets	-0.9821						
Net Income / Total Assets	0.9841						
Cash Flow / Total Capital					0.9856		
Capital Turnover							
Sales / Net Plant							0.4622
Sales / Total Assets						0.8597	
Cash Flow / Sales					0.9732		
Net Income / Sales	0.9727						
Sales / Total Capital						0.8709	
Inventory Turnover		D				F	
Inventory / Sales		0.8905					
COGS / Inventory							0.8061
Working Capital / Total Assets						-0.4234	
Current Assets / Sales		0.5505					
Sales / Working Capital	0.3014						
Receivables Turnover							
Receivables / Inventory							0.8512
Receivables / Sales		0.9135					
Inventory / Current Assets		0.8296					
Quick Assets / Sales		0.8562					
Financial Leverage			B				
Debt / Total Capital			0.9057				
Debt / Total Assets			0.9043				
Total Liability / Net Worth			0.8230				
Total Assets / Net Worth						-0.6308	
Short Term Liquidity							
Current Assets / Current Liabilities			-0.7325				
Quick Assets / Current Liabilities			-0.6048				
Current Liabilities / Net Worth			0.8371				
Inventory / Working Capital		0.6590					
Current Assets / Total Assets		0.6484					
Cash Position				C			
Cash / Total Assets				0.9556			
Cash / Fund Expenditure				0.9803			
Cash / Sales				0.9760			
Cash / Current Liabilities				0.9650			
Quick Assets / Fund Expenditures		0.7884					

Table 14.

Decline Data Set	Factor Loadings						
PCHG of Financial Ratios	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Return on Investment	A						
Total Income / Total Capital	0.9885						
Net Income / Net Worth	0.9883						
Total Income / Sales	0.9882						
Cash Flow / Total Assets					E		
Cash Flow / Net Worth					0.9915		
Total Income / Total Assets	0.9883				0.9807		
Net Income / Total Assets	0.9886						
Cash Flow / Total Capital					0.9912		
Capital Turnover			D				
Sales / Net Plant			-0.5714				
Sales / Total Assets			-0.9152				
Cash Flow / Sales					0.9923		
Net Income / Sales	0.9885						
Sales / Total Capital			-0.7762				
Inventory Turnover							
Inventory / Sales			0.6357				
COGS / Inventory						0.6585	
Working Capital / Total Assets						0.3270	
Current Assets / Sales			0.7835				
Sales / Working Capital							0.8204
Receivables Turnover							
Receivables / Inventory						0.6857	
Receivables / Sales			0.5779				
Inventory / Current Assets						-0.7628	
Quick Assets / Sales			0.8039				
Financial Leverage		B					
Debt / Total Capital		0.8974					
Debt / Total Assets		0.9141					
Total Liability / Net Worth		0.8732					
Total Assets / Net Worth		0.7017					
Short Term Liquidity							
Current Assets / Current Liabilities							-0.6309
Quick Assets / Current Liabilities							-0.4309
Current Liabilities / Net Worth		0.9340					
Inventory / Working Capital							0.8172
Current Assets / Total Assets		0.4454					
Cash Position				C			
Cash / Total Assets				0.9722			
Cash / Fund Expenditure				0.9812			
Cash / Sales				0.9760			
Cash / Current Liabilities				0.9674			
Quick Assets / Fund Expenditures			0.8070				

Table 15.

C. IMPLICATIONS

The discussion of the previous analysis results provided a number of different observations. The objective of this section is to summarize these observations together. This will be done by specifying the dimensions of change collectively, identifying their most representative ratios, discussing the overall consistency of these ratios and comparing the dimensions of change with the dimensions of financial condition. These implications will provide for the conclusions to be drawn in the final Chapter.

1. Specifying the Dimensions of Change

The analysis on the dimensions of change began with the pooled data set using both the ACHG and PCHG measures to identify groups of ratios with a unique factor. An important observation from the two results is that the ACHG measure seemed to group ratios that shared a common element in the ratios. The PCHG measure seemed to group ratios that shared a common concept the ratios reflected. With this observation and given the mixed results of the ACHG measure during the stability analysis, the preferred measure would be the PCHG measure. Therefore, the results from the PCHG pooled data set, factors "A" through "F" in Table 11, can be identified as the primary dimensions of change. To indicate the concepts these dimensions of change represent, labels will be specified to reflect their meaning. The label "A" is representative of *Change in Income*, "B" is representative of *Change in Leverage*, "C" is representative of *Change in Cash Position*, "D" is representative of *Change in Assets Turnover*, "E" is representative of *Change in Cash Flow* and "F" is representative of *Change in Capital Turnover*. The ratios which make up these primary dimensions of change will be discussed in the following section.

2. Most Representative Ratios

The most representative ratios for each of the primary dimensions of change can be identified from the analysis discussed above. The factor analysis procedure assigns a factor loading to each individual ratio. This loading represents how highly correlated the ratio is to an individual factor. The six individual factors that represent the primary dimensions of change are reproduced in Table 16. Ratios are then listed in order of highest correlation to

the lowest correlation with these factors, in Table 16. This list excludes any ratios that were lower than a ±0.70 factor loading.

Table 16 suggests the higher the factor loading of a ratio within a dimension of change the more representative that ratio is of that dimension of change. However, this does not take into consideration whether these representative ratios were consistent in all situations. Therefore, a discussion on the consistency of these most representative ratios will be evaluated in the next section.

3. Consistency of Ratios

To evaluate the consistency of the ratios in Table 16 an investigation of more than the "pooled" data set is necessary. When the data set is changed, the factor loadings may change and possibly cause a ratio to load with another factor or not load as highly as on a different data set. Therefore, the consistency of where the ratios load highly may be evaluated by comparing across data sets. This will be done by examining the occurrence consistency of the ratios in the "annual" data sets, the "growth" data set and the "decline" data set.

There were five significant observations involving the consistency of the ratios. First, all the ratios for the *Change in Leverage* and the *Change in Cash Position* dimensions of change occurred throughout the "annual" data sets, the "growth" data set and the "decline" data sets. This suggest the ratios representing *Change in Leverage* and the *Change in Cash Position* in Table 16 are consistent. Second, all the ratios for *Change in Income* occurred throughout the "growth" data set and the "decline" data sets, but some of the ratios did not occur in four of the annual data sets. In these four annual data sets the ratios with Total Income were independent of the ratios with Net Income. The difference in occurrence in these four annual data sets seemed to be related to an element of the ratio. Therefore, all the ratios representing *Change in Income* will be considered consistent, given consideration of the difference in the measures of income. Third, the only consistent ratio for *Change in Assets Turnover* in all the data sets was Inventory / Sales. Fourth, all the ratios for *Change in Cash Flow* occurred throughout the "growth" data set and the "decline" data sets, but some of the ratios did not occur in two of the annual data sets. The failure of occurrence of some of the ratios will be disregarded since this only occurred twice. All the ratios for this

dimension of change will be considered consistent. The final observation was both ratios for *Change in Capital Turnover* were consistent only in the "growth" data set and the annual data sets that made up the growth years. Both of these ratios will only be considered consistent during years of economic growth. As described by these observations, there are two dimensions of change that revealed negligible inconsistency with respect to individual ratios. The most representative ratios of the primary dimensions of change and these noted inconsistencies are described in Table 16.

Dimension of Change:	Financial Ratio:
Change in Income	
	Net Income / Net Worth
	Total Income / Sales
	Total Income / Total Assets
	Total Income / Total Capital
	Net Income / Sales
	Net Income / Total Assets
Change in Leverage	
	Current Liabilities / Net Worth
	Total Liability / Net Worth
	Debt / Total Capital
	Debt / Total Assets
Change in Cash Position	
	Cash / Fund Expenditure
	Cash / Sales
	Cash / Total Assets
	Cash / Current Liabilities
Change in Assets Turnover	
	Inventory / Sales
	† Receivables / Sales
	† Sales / Working Capital
Change in Cash Flow	
	Cash Flow / Total Assets
	Cash Flow / Total Capital
	Cash Flow / Sales
	Cash Flow / Net Worth
Change in Capital Turnover	
	* Sales / Total Assets
	* Sales / Total Capital

† Ratios with inconsistency

* Ratios consistent only during periods of Economic Growth

Table 16.

4. Dimensions of Change versus Dimensions of Financial Condition

The analysis conducted to compare the dimensions of change with the dimensions of financial condition consisted of comparing the overlap of ratios that make up both dimensions. The ratios of the primary dimensions of change are as described in the previous sections. The ratios of the dimensions of financial condition were described in the first analysis section of this Chapter. The dimensions of financial condition that existed for this sample are Return on Investment, Cash Position, Inventory Turnover, Receivables Turnover, Financial Leverage and Short Term Liquidity.

There were four observations made of this comparison. First, all the ratios that were verified to exist with single Return on Investment dimension were contained by two chnage dimensions, *Change in Income* and *Change in Cash Flow*. This suggests a unique difference occurs when considering the change of Return on Investment. Second, all the ratios that were verified to exist with Cash Position were only contained by the dimension *Change in Cash Position*. This observation revealed there is no difference between the two dimensions. Third, the ratios that were verified to exist for two Financial Leverage and Short Term Liquidity dimensions were contained by the single dimension, *Change in Leverage.* This suggest *Change in Leverage* is a combination of these two dimensions of financial condition. Or stated differently, when *Change in Leverage* and *Short Term Liquidity* occur, they appear to happen simultaneously such that only one change dimension, *Change in Leverage*, is exhibited. Fourth, the lack of stability and inconsistency of the change dimensions, *Change in Assets Turnover* and *Change in Capital Turnover,* resulted in there being little comparability between them and any of the dimensions of financial condition.

V. CONCLUSION

A. OBJECTIVES

The objective of this chapter is to summarize the conclusions made from the research conducted for this thesis. The conclusions will first be summarized by answering the research questions. These answers will be based on the results of the analysis performed in Chapter IV. The remaining conclusions will then be summarized with the recommend applications of this research.

B. ANSWERS TO RESEARCH QUESTIONS

What are the primary dimensions of changes in financial conditions for defense industry firms? (Primary Research Question) The analysis conducted to answer this question consisted of examining a sample of fifty defense industry firms. The annual percent change of thirty-six financial ratios were calculated for each firm's 1983 to 1992 financial data. Measures of the ten years were pooled together into one data set. Factor analysis conducted on this data identified the association of ratio change measures with unique factors, thereby establishing an empirical link. These unique factors are the primary dimensions of change and the answers to the *Primary Research Question*. These were given labels that most accurately represents the dimensions of change they describe.

- *Change in Income* - a dimension that represents change over period of time in a firm's revenues and expenses.
- *Change in Leverage* - a dimension that represents a change in firms use of debt financing. This can be associated with changes in risk the firm is taking on over periods of time.
- *Change in Cash Position* - a dimension that represents a firm changing over periods of time in its ability to meet financial obligations with cash.
- *Change in Assets Turnover* - a dimension that represents changes over periods of time in a firm's use of its resources.
- *Change in Cash Flow* - a dimension that represents the changes over periods of time between the sources of cash and uses of cash.

- *Change in Capital Turnover* - a dimension that represents changes over a period of time in a firm's use of its invested assets.

Changes in a firm's financial condition over a period of time can be captured by changes in ratios representing these six dimensions. *Are these dimensions of change stable over time? (Subsidiary Research Question 1)* The analysis conducted to answer this question used the same sample, but the pattern of ratio changes were examined yearly. Comparisons were then made of the overlap between these yearly tests and the previous pooled analysis. This comparison yielded the following stability results:

- *Change in Leverage* and *Change in Cash Position* are stable
- *Change in Income* and *Change in Cash Flow* are predominantly stable
- *Change in Assets Turnover* is less stable
- *Change in Capital Turnover* is not stable

These results provide the answer to *Subsidiary Research Question 1* and an insight to be weighed when dimensions of change are considered. *Are these dimensions of change and representative ratios consistent during periods of economic growth and decline? (Subsidiary Research Question 2)* The analysis conducted to answer this question used the same sample, but the pattern of ratio changes were examined separately for a growth period and a decline period. Comparisons were then made of the overlap in findings between these two periods and with the dimensions of change identified by the first analysis. This comparison yielded the following results:

- During periods of economic growth all the dimensions of change and the ratios that represent them are consistent.
- During periods of economic decline four of the dimensions of change and the ratios that represent them are consistent. *Change in Assets Turnover* is moderately consistent and *Change in Capital Turnover* is not consistent.

These results answer *Subsidiary Research Question 2* and provide another insight to be weighed when dimensions of change are considered. The comparison between the economic periods indicates all of a firm's dimension of change are stable when the economy is growing. However, in a declining economy only the dimensions of *Change in Leverage, Change in Cash Position, Change in Income* and *Change in Cash Flow* are stable.

The specific ratios representing the dimensions of change are of particular importance. *What individual ratios are most highly associated with each dimension of change? (Subsidiary Research Question 3)* The answer to this question is contained in the analysis used to find the dimensions of change. The correlation of ratio changes to factors were represented by factor loadings. These factor loadings were arranged from highest to lowest within each dimension of change and this ranking provides the answer to *Subsidiary Research Question 3*. Before presenting these answers it is appropriate to consider the consistency of these ratios with respect to their association with the dimensions of change. *Are these representative ratios consistent over time? (Subsidiary Research Question 4)* The analysis conducted to answer this question involved comparing the results for *Subsidiary Research Question 1* and *Subsidiary Research Question 2.* A description of the results follow.

- All the ratios that represent *Change in Leverage, Change in Cash Position, Change in Income* and *Change in Cash Flow* are consistent over time.
- *Change in Assets Turnover* has only one ratio that is consistent and ratios for *Change in Capital Turnover* are only consistent with years that represent economic growth.

These observations provide answers to the previous questions, however they can be more clearly described by reproducing the results from Chapter IV. Table 17 depicts the most representative ratios of the dimensions of change and there noted inconsistencies.

Dimension of Change:	Financial Ratio:
Change in Income	
	Net Income / Net Worth
	Total Income / Sales
	Total Income / Total Assets
	Total Income / Total Capital
	Net Income / Sales
	Net Income / Total Assets
Change in Leverage	
	Current Liabilities / Net Worth
	Total Liability / Net Worth
	Debt / Total Capital
	Debt / Total Assets
Change in Cash Position	
	Cash / Fund Expenditure
	Cash / Sales
	Cash / Total Assets
	Cash / Current Liabilities
Change in Assets Turnover	
	Inventory / Sales
	† Receivables / Sales
	† Sales / Working Capital
Change in Cash Flow	
	Cash Flow / Total Assets
	Cash Flow / Total Capital
	Cash Flow / Sales
	Cash Flow / Net Worth
Change in Capital Turnover	
	* Sales / Total Assets
	* Sales / Total Capital

† Ratios with inconsistency

* Ratios consistent only during periods of Economic Growth

Table 17.

The dimensions of change represent six unique measures of change that occur to a firm's financial condition. *Are the dimensions of change related to the dimensions of financial condition? (Subsidiary Research Question 5)* The analysis to answer this question was conducted by first identifying the dimension of financial condition for this sample. Factor analysis was conducted to find correlation of the ratios (not the change in ratios) with unique factors. These unique factors were then compared with dimensions of financial condition suggested by the seven category framework from previous studies [Ref. 1, 2, 3 and 4]. The analysis then consisted of comparing the ratios that make up these dimensions of financial conditions with the ratios that make up the dimensions of change. The results are as follows:

- *Change in Income* and *Change in Cash Flow* are related to Return on Investment, but they represent two uniquely different measures of change.

- *Change in Leverage* contains ratios from both Financial Leverage and Short Term Liquidity, therefore the relationship that exist is a combination of these two dimensions.

- *Change in Cash Position* is made up of the same ratios as Cash Position which implies the only difference in the relationship is the measure of ratio change.

- *Change in Assets Turnover* and *Change in Capital Turnover* do not show any discernable relationships, which is a result of their instability.

C. APPLICATIONS

The applications of this thesis is based on the answers to the research questions discussed above. The empirical linking of changes in ratios to unique dimensions is important. These unique dimensions are reflecting changes in financial condition that are measurable by specific financial ratios (when measured by percent change). The knowledge that financial condition changes along unique dimensions provides a tool for evaluating the historical performance of a firm so that predictions of future performance can be made. In short, the dimensions of change provide a framework for conducting an analysis of changes in financial condition.

The framework for analyzing changes in financial conditions consist of the six dimensions described in Table 17. These six dimensions are independent of one another. Consequently, the framework provides the ability to analyze a specific non-overlapping dimension of a firm's financial condition. A financial analysis conducted by paying attention to the six specific dimensions of change would be both comprehensive and non-redundant. To conduct such a financial analysis, specific ratios would be used to measure each of the six dimensions of the framework. The analysis in this thesis reduced the number of ratios and selected the most representative ratios (Table 17) for each dimension. These ratios may also be considered comprehensive and non-redundant. Therefore, a financial analysis that considers this framework would be able to measure six unique dimensions of change of a firm's financial condition.

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