

1988

A Comparison of the Effectiveness of the Operating Funds Flow Measures of Cash, Net Quick Assets, and Working Capital in Predicting Future Cash Flow.

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measures of cash, net quick assets, and working capital in
predicting future cash flow**

Gaharan, Catherine Innes Green, Ph.D.

The Louisiana State University and Agricultural and Mechanical Col., 1988

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Ann Arbor, MI 48106

A Comparison of the Effectiveness of the
Operating Funds Flow Measures of
Cash, Net Quick Assets, and Working Capital
In Predicting Future Cash Flow

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Accounting

by

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May 1988

ACKNOWLEDGMENTS

I appreciate the help and support I received while completing this dissertation. I am particularly grateful to the chairman of my dissertation committee, Professor William G. Mister, who readily contributed his time and advice in helping to shape and complete this research project. To all of the members of my dissertation committee, Professors Nicholas Apostolou, Margaret Shelton, Jerry Strawser, Helmut Schnieder, and James Werbel who generously provided valuable suggestions and technical council, I extend my thanks.

The data bank and the computer time needed for the data analyses were provided by Louisiana State University, for which I am grateful. I am especially grateful for the programming assistance provided by the System Network Computer Center User Services Help Desk. I am also thankful for the computer time which was provided by Nicholls State University College of Business Administration.

I am thankful for the friends who helped and encouraged me in this project. Mona Zeringue and Sheila Zeringue provided typing assistance. Professor Jim Ponder provided

time and encouragement. Many other friends at Nicholls State University also provided encouragement and technical assistance, for which I am grateful.

I am especially grateful to my family. My parents and my children supported and encouraged me throughout my doctoral studies. My special thanks go to my husband, Charles A. Gaharan, for his understanding and sacrifice while I was completing the work required in my Ph.D. program.

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ABSTRACT

In Statement of Financial Accounting Standards No. 95, "Statement of Cash Flows," the Financial Accounting Standards Board requires a statement of cash flows in place of a statement of changes in financial position. This information is assumed to be useful in predicting future cash flow.

The first part of this three-part study empirically tests this assumption by comparing the abilities of three operating funds flow measures (working capital, net quick assets, and cash) to predict future cash flows. The second part of this study determines whether the reporting concept best for predicting future cash flow is dependent upon industry classification. The third part examines whether differences in the abilities of the three operating funds flow measures to predict future cash flow are affected by differences in the components of the current assets and current liabilities of a firm.

Data for 454 firms were obtained from Compustat for the ten-year period from 1976-1985. Variables examined in the study included the three operating funds flow measures as

independent variables and one dependent variable, future cash flow from operations.

A cross-sectional, time series regression model was used in each of the three parts of this study. In the first part, each independent variable was tested by using all of the firms in three separate regression analyses. In the second part of the study, the firms were grouped according to industry classification. Each industry was tested with three separate regression analyses. In the third part of the study, the firms were grouped by cluster analysis according to similarities in the composition of their current assets and current liabilities. The resulting four clusters were each tested separately by using three regression analyses.

Results of tests of the first part of this study indicate that working capital from operations is the best predictor of future cash flow. Results of tests of the second part of this study indicate that the effectiveness with which each of the operating funds flow measures predicts future cash flow varies across industries. Results of tests of the third part of this study were inconclusive.

CHAPTER ONE

INTRODUCTION

Prior to November 1987, financial accounting standards allowed firms the flexibility to report operating funds flow information by using any of several reporting concepts (Accounting Principles Board Opinion 19, 1971). However, in November 1987, the Financial Accounting Standards Board (FASB) promulgated Statement of Financial Accounting Standards (SFAS) No. 95, "Statement of Cash Flows," which superceded Accounting Principles Board Opinion (APBO) No. 19, "Reporting Changes in Financial Position" (1971). SFAS No. 95 requires that all firms use cash flow from operations for financial reporting after July 15, 1988. The importance of providing information useful for predicting future cash flow has been established as a priority by the FASB. The question addressed by this research is whether cash flow from operations is more effective in predicting the future cash flow of a firm than the two previously allowed alternative reporting concepts--net quick assets from operations and working capital from operations.¹

This study consists of three parts. In the first part the general effectiveness with which the three alternative measures predict future cash flow from operations are compared. In the second part differences in the predictive ability of the three alternative measures across industries are investigated. In the third part company characteristics which are believed to cause differences in the effectiveness with which each funds flow measure is able to predict future cash flow are tested to determine if a priori expectations can be supported.

Under the provisions of APBO No. 19 firms were allowed the flexibility to select the reporting concept (based on cash, net quick assets, working capital, or some other concept) in presenting the statement of changes in financial position. The Accounting Principles Board (APB), noting the likelihood that circumstances of each firm will differ, stated, "Each entity should adopt the presentation that is most informative in its circumstances" (para. 9). However, the recently issued SFAS No. 95, which superceded APBO No. 19 requires a statement of cash flows and excludes other funds flow measures.

The question that remains is whether the presentation of an operating funds flow measure based on cash, to the exclusion of other bases, provides optimal information for the prediction of future cash flow for all types of firms. The FASB believes that a statement of cash flows will help financial statement users to "assess the entity's ability to

generate positive future net cash flows" (1987, para. 5). However, empirical studies have found that other operating funds flow measures actually predict future cash flow better than cash flow from operations.²

Purposes of Study

One purpose of this study is to add to existing research in the empirical determination of which operating funds flow measure--cash, net quick assets, or working capital--is more effective in predicting future cash flow from operations. Many of the articles and research studies supporting the need for cash flow information either assumed or theoretically justified that current cash flow information is better for predicting future cash flow than other funds flow measures such as net quick assets or working capital from operations.³ However, a review of the literature has revealed three empirical studies which found working capital from operations to be a better predictor of future cash flow than cash flow from operations (see end note 2). In addition, another study found that operating income predicted future cash flow better than cash flow from operations (Greenberg et al., 1986).

A second purpose of this study is to compare the ability of the operating funds flow measures of cash, net quick assets, and working capital to predict future cash flow across industries in order to determine which is the best predictor for each industry. Since industry characteristics have been found to affect the ability of

accrual accounting measures to predict future cash flow (Costigan, 1985), this study determines whether industry characteristics also affect the ability of these three funds flow measures to predict future cash flow. Several studies have examined the existence of industry effects and their usefulness in explaining variations in other dependent variables.⁴ Yet, a review of the literature has found no studies attempting to compare the effectiveness of the three operating funds flow measures of cash, net quick assets, and working capital in predicting future cash flow for different industries.

Inconclusive results of studies comparing accrual accounting and cash accounting further indicate that factors not accounted for (possibly differences in industry) are affecting the abilities of accrual accounting and cash accounting measures to predict future events. Some of these empirical studies have compared the effectiveness of accrual accounting measures and cash accounting measures in predicting bankruptcy. Their results have been conflicting. Of the five such studies examined, two found that cash accounting variables predicted bankruptcy better (Largay and Stickney, 1980; Gentry et al., September-October, 1985); one found the accrual accounting variables to predict better (Casey and Bartczak, 1984); and the other two found that cash variables were unable to add to the predictive power of accrual variables (Casey and Bartczak, 1985; Gentry et al. Spring, 1985).

Still other studies, also with conflicting results, have attempted to determine whether cash accounting variables and accrual accounting variables contain essentially the same information--whether cash accounting and accrual accounting are two different measures. Cash flow variables were found to contain information not found in accrual measures in three of six such studies examined (Bowen et al., 1986; Gombola and Ketz, January, 1983 and September-October, 1983). However, of the other three studies examined, two found that cash flow variables and working capital variables contained essentially the same information (Drtna and Largay, 1985; Gombola and Ketz, 1981). The remaining study found that while the dollar amount of cash flow was different from the dollar amount of working capital flow, annual changes in these measures were not clearly different (Thode et al., 1986).

A third purpose of this study is to determine whether company characteristics influence the effectiveness of the three operating funds flow measures as a priori expected. Expected company differences in the effectiveness of the three operating funds flow measures of cash, net quick assets, and working capital in predicting future cash flow from operations are evident through an examination of and a comparison of the components of these funds flow measures. Accrual components must be included in each funds flow measure in the reconciliation of cash flow from operations

to both net quick assets from operations and working capital from operations.

A change from using cash flow from operations to using net quick assets from operations as the operating funds flow measure involves the inclusion of current receivables and current liabilities. According to Statement of Financial Accounting Concepts 3, "Elements of Financial Statements of Business Enterprises" (1980), an asset represents future economic benefits and a liability represents future economic sacrifices to a firm. Further, Chapter 3 of Accounting Research Bulletin 43, "Working Capital" (1953), explains that current accounts are expected to be realized within the following accounting period.

Both pronouncements indicate that since the gross amounts of some current accounts are not necessarily the amounts that are ultimately expected to be received or paid, their valuation accounts are useful for projecting more meaningful values of expected future cash inflows and outflows from these current accounts. Costigan (1985) pointed out that these valuation accounts represent a source of information about future cash flow unavailable from a cash accounting system. In companies in which large amounts of receivables and payables, relative to total current assets, are present, then, additional information is available from net quick assets from operations that is unavailable from cash flow from operations. Thus, the expectation is that for these companies, net quick assets

from operations will be a better predictor of future cash flow than cash flow from operations.

Conversely, companies having small amounts of current receivables and payables, relative to total current assets, are expected to find cash flow from operations to be the better predictor of future cash flow from operations. In these companies, the current level of cash flow from operations is expected to influence the level of future cash flow from operations. The effect of any additional cash flows caused by collection of the small amounts of receivables or payment of the small amounts of payables is expected to be negligible.

Finally, utilizing working capital from operations as the operating funds flow measure involves the inclusion of the remaining current assets, including inventories. Companies with large amounts of inventory, relative to total current assets, are expected to find working capital from operations to be a better predictor of future cash flow from operations than either cash flow from operations or net quick assets from operations. Hendriksen (1982) pointed out that inventories represent both a future cash inflow as well as a future cash outflow. Future cash inflows are available from the sale of existing inventories while the replacement of those inventories will require future cash outflows. Further, as the relative size of inventories increases, the expected amount of future cash inflows and cash outflows increases. Thus, a substantial portion of future cash flows

will be due to inventory transactions in those companies having relatively large levels of inventory with respect to total current assets.

In this analysis, the relative values of receivables, payables, and inventory are more useful than their absolute values. Moreover, the composition of accounts within a firm's current assets and the portion of these current assets that is needed to satisfy current liabilities are expected to be determinants of which funds flow measure is the best predictor of future cash flow. Therefore, the amounts of a firm's receivables, payables and inventory are measured relative to its total current assets.

Research Questions

The three research questions investigated in this study are:

- (1) Among the operating funds flow measures of cash, net quick assets, and working capital, which measure is the most accurate predictor of future cash flow?
- (2) Is the effectiveness of the operating funds flow measures of cash, net quick assets, and working capital in predicting future cash flow the same across industries?
- (3) Do company characteristics influence the effectiveness of the three operating funds flow measures in predicting future cash flow as a priori expected?

Importance of Study

The importance of providing information useful in predicting future cash flow has been established by the FASB. In Concepts Statement No. 1, "Objectives of

Financial Reporting by Business Enterprises," the FASB pointed out the need for financial statements to

provide information to help investors, creditors and others assess the amounts, timing, and uncertainty of prospective net cash inflows to the related enterprise (FASB, 1978, p. viii).

Considering the importance the FASB has placed on the prediction of future cash flow, the most useful disclosures would be those that best aid in predicting future cash flow. The results of this study provide insight as to which operating funds flow measure provides the most useful information for predicting future cash flow.

Justification of Study

The results of an investigation of the first research question provide evidence as to which operating funds flow measure is best able to predict future cash flow. This evidence adds to existing research which has found that working capital from operations is a better predictor of future cash flow than cash flow from operations. Any differences between the results of this study and those of prior studies may be due to differences in the methodology used or due to differences in the sample used. Since the methodology used in this study is an improvement over that of prior studies and since the sample size used in this study is larger than that used in other studies, differences in the results of this study should be further investigated.

The second research question examines differences in the relative effectiveness of each of the three operating

funds flow concepts of cash, net quick assets, and working capital in predicting future cash flow across industries. If operating cash flow is found to be the best predictor of future cash flow for all industry classes, the requirement that all firms should use a cash flow statement is supported. If, on the other hand, either of the other operating funds flow measures is found to be a better predictor for some industries, the requirement for all firms to include a cash flow statement may not serve the intended purpose of the FASB. In this case, a standard that allows flexibility in the reporting concept may have been more appropriate. Although a more flexible standard would not insure that firms would always use the funds flow measure that best predicts future cash flow, it would allow them the opportunity to present the most useful measure in each circumstance.

The desirability of flexible financial accounting standards has been debated in earlier research. In his study of differences in the predictive ability of accrual earnings measures across industries, Costigan (1985) pointed out that

There is the possibility that the ability of certain components to communicate differs across industries which up to the present has not been recognized in the conceptual statements of the FASB. It is possible that users of financial reports would be better served by reporting standards that vary across industries in hopes of providing the most useful information for each firm (Costigan, 1985, p. 36).

An investigation of the third research question provides evidence of whether a priori expectations of the effectiveness of the three funds flow measures in predicting future cash flow for firms with different characteristics is supported. If the results of this study support a priori expectations, financial statement users will be provided with insight as to which funds flow measure is likely to be most useful for predicting future cash flow for firms with different characteristics.

Methodology

The methodology used in this study is designed to determine which operating funds flow measure--cash, net quick assets, or working capital--is most useful in predicting future cash flow from operations; whether their predictive effectiveness varies across industries; and whether the a priori expectations of which funds flow measure is the most effective predictor of future cash flow for firms with different characteristics can be supported. The funds flow measures analyzed in this study differ only with respect to current accounts. Since the cash flow from these current accounts is expected to be realized during the following accounting period, the future cash flow of interest in this study is the following year's cash flow from operations.

The study was conducted in three phases using ten years' of Compustat data from 1976-1985. All firms on the

Compustat tapes during this time period that met the requirements of this research were included. The resulting sample totaled 454 firms.

In each phase the focus is on finding the relationship between future cash flow from operations and each of the three operating funds flow measures of cash, net quick assets, and working capital. To measure the strength of these relationships, ordinary least squares regression was used. Because these relationships are determined over a period of time, an additional problem that was considered is the possibility of serial correlation or autocorrelation of the data. For those regression models exhibiting an autocorrelation problem, a regression model incorporating information with respect to the pattern of the systematic variation was used. For regression models with no autocorrelation problems, the results of the ordinary least squares regression analysis was used.

Three separate models were used for each group of firms. Each model had as its dependent variable future cash flow from operations. The independent or predictor variable was cash flow from operations in one model, net quick assets from operations in a second model, and working capital from operations in a third model.

The effectiveness of the independent variables in predicting future cash flow from operations was determined by comparing the strength of the relationship between each of the independent variables and future cash flow from

operations. Since the coefficient of determination (r^2) is a measure of the ability of the independent variable to statistically explain the variability in the dependent variable, it was used to measure the strength of each relationship. Thus, the independent variable whose coefficient of determination is largest, as determined by a statistical test of significance (the F test), is regarded as having the greatest ability to predict future cash flow from operations.

In the first phase of the analysis, the operating funds flow measure that produces the largest statistically significant coefficient of determination for a model consisting of all of the companies included in the study is considered the most effective in predicting future cash flow from operations. In the second phase, the companies were grouped into industry classifications based on their two-digit Enterprise Standard Industrial Classification (SIC) code. If the operating funds flow measure most effective in predicting future cash flow from operations differs across industries, the contention that industry factors affect the ability of the operating funds flow measures to predict future cash flow is supported. In the third phase, the firms were clustered into groups based on the relative sizes of each firm's accounts receivable, inventory, and accounts payable. Then, the a priori expectations for each clustered group of firms was determined. The expected results were compared to the operating funds flow measure empirically

found to be most effective in predicting future cash flow for each clustered group of firms. Results indicating that these comparisons are similar would substantiate a priori expected relationships.

Organization of Study

The following chapter examines prior research relevant to this study. The prior research has neither produced conclusive results, nor thoroughly investigated the research questions of this study. The objective of this study is to provide more conclusive results that will resolve research questions.

The third chapter explains the methodology that was used to investigate the research questions. Research hypotheses are developed, and their expectations are explained. The models and variables used are described as well as the selection of firms and the time period of interest.

Statistical tests used in this study are presented in the fourth chapter. Their results are analyzed and reported. These results are then compared to the expected results based on results of prior research and a priori expectations.

The concluding chapter summarizes the results of this research and discusses its implications. It also points out limitations inherent in this study. Finally, this chapter

identifies additional areas of research that are needed to explain or to substantiate this study.

End Notes

¹These measures are defined as follows: cash flow from operations is the net change in cash from operating activity (cash inflows from operations minus cash outflows from operations); net quick assets from operations is the net change in net liquid assets (cash, temporary investments, and current receivables minus current liabilities) from operating activity; working capital from operations is the net change in net current assets (current assets minus current liabilities) resulting from operating activity. Working capital and net quick assets are accrual measures; and cash flow is a purely cash measure. Because of the difficulty in obtaining true measures of cash flow from operations, net quick assets from operations, and working capital from operations, the measures used in this study must be considered surrogates of the true measures of operations.

²See Fisher, 1980; Costigan, 1985; and Bowen et al., 1986. These researchers all found that working capital from operations predicted future cash flow better than cash flow from operations.

³For example, FASB, 1978; FASB, 1980; FASB, 1981; AICPA, 1973; Report of the Advisory Committee on Corporate Disclosure to the Securities and Exchange Commission, Congress, 1977; Seed, 1978; Heath, 1978; Securities and Exchange Commission, 1980; Financial Accounting Foundation, 1980; Ijiri, 1978 and 1980; Swanson and Vangermeersch, 1981.

⁴For example, King (1966) found that industry effects explained 10% of the variability of a firm's stock returns. Brown and Ball (1967) found that between 10% and 15% of the variability of a firm's earnings could be explained by industry effects. Manes, Samuels, and Smith (1967) found differences across the three industries they examined in the relationship of inventory to sales. Nerlove (1968) found that the inclusion of industry variables increased the power of his model to explain differences in rates of return on investments in common stock. Frank (1969) found that in predicting earnings, the forecast errors differed across the six industries he examined. Magee (1974) found that by using a four-digit SIC number, the correlation of an industry effect with unexplained earnings changes was significant even after removing market effects. Albrecht, Lookabill, and McKeown (1977) found industry differences in the time series behavior of earnings across the three

industries they examined. Watts and Leftwich (1977) found that the ability to forecast earnings differed across the three industries they examined. Fabozzi and Francis (1979) found that by including industry variables the power of their model to explain a firm's systematic risk was significantly improved. Gombola and Ketz (1981) found that the relationships between their variables differed across industries. Foster (1986) found that an industry variable explained 36% of variations in net income changes of a firm.

CHAPTER TWO

LITERATURE REVIEW

This chapter will review the literature in the two areas of empirical research relevant to this study. One area of research consists of studies that have compared cash accounting and accrual accounting. Research studies which are discussed in this area include those that have compared the abilities of cash and accrual accounting to predict firm failure, those that have compared the abilities of cash and accrual accounting to predict future cash flow, and those that have investigated similarities and differences in the properties of cash and accrual accounting measures. The review of these studies will reveal that neither cash accounting measures nor accrual accounting measures can always be considered more useful than the other in predicting a firm's performance. This review will also illustrate that the two types of measures usually exhibit distinct differences such that one type of measure cannot reliably be used as a substitute for the other.

The other area consists of studies that have investigated the effects of differences in industry type. This review will include several studies which have established the existence of and the importance of industry effects. In particular, a number of these studies reveal the influence that industry type plays on the prediction of future events, including the prediction of future cash flow.

Comparison of Cash and Accrual Accounting Measures

The need to provide accounting information that is useful for predicting a firm's future cash flow has been established (FASB, 1978). Based on this need, the primary justification for the proposal that all firms be required to present cash flow from operations rather than an optional funds flow measure is that cash flow from operations will be useful in predicting future cash flow (FASB, 1987). However, studies that will be reviewed in this section indicate that accrual accounting measures appear to have an edge over cash accounting measures in their ability to predict future events of a firm. Yet, these studies also indicate that neither cash nor accrual accounting is clearly superior in predicting future events in all cases. Studies reviewed in this section will further indicate that the properties of cash and accrual accounting measures are be different.

Three approaches that have been used in research comparing cash and accrual accounting will be examined. In

one approach, studies have assessed, with conflicting results, the relative ability of the two reporting bases to predict firm failure. In a second approach, studies have assessed the relative ability of each of the bases to predict future cash flow and found that accrual measures of earnings usually predict future cash flow better than cash measures of earnings. The third approach has been to determine whether the two different types of measures contain essentially the same properties. Research using this approach has also been inconclusive.

Prediction of Firm Failure

This section reviews four studies which compare the ability of cash accounting variables and accrual accounting variables to predict firm failure. These four studies are reviewed (from among the numerous firm failure studies) because the variables used in these studies are more clearly a comparison of the predictive ability of cash and accrual variables than the variables used in other firm failure studies. Results of these studies are mixed. One study found that cash accounting variables have more power to predict bankruptcy than accrual variables (Largay and Stickney, 1980). Results of one of the studies indicate that accrual measures are better able to predict bankruptcy than cash measures (Casey and Bartczak, 1984). The remaining two studies (Casey and Bartczak, 1985 and Gentry et al., Spring, 1985) indicate that cash accounting measures

are unable to improve the predictive ability of a model of accrual accounting measures.

These results question the ability of either type of measure to surpass the other in predicting firm failure in all cases. Although accrual measures were found to be better predictors of firm failure than cash measures, they were unable to predict firm failure 100% correctly. Thus, cash measures may be better able to predict firm failure for some types of firms. Further, since cash and accrual measures exhibit differences in their ability to predict firm failure, the properties of the two measures appear to be different.

Largay and Stickney (1980)

One of the first studies to illustrate the difference in the predictive ability between cash flow from operations and working capital from operations was "Cash Flows, Ratio Analysis and the W. T. Grant Company Bankruptcy" by James A. Largay III and Clyde P. Stickney (1980). In this study, the authors illustrate that although W. T. Grant's net income and its working capital provided by operations was positive for each of the nine years prior to its bankruptcy, its cash flow from operations (derived by adjusting working capital from operations by changes in current accounts other than cash) was negative in all except two of its last ten years. From this, Largay and Stickney surmise that an analysis of cash flow from operations could have been used to predict

problems sooner than an analysis of working capital provided by operations.

Largay and Stickney's graph of net income, working capital and cash flow from operations for the W. T. Grant Company's last ten years illustrated that neither the company's working capital provided by operations nor its net income correlated with its cash flow from operations. As the authors point out, the lack of correlation indicates that working capital from operations may not be a good approximation of cash flow from operations.

Several studies have used a cash flow variable which was computed by simply adding depreciation and amortization back to net income.¹ Since this measure more nearly approximates working capital from operations than it does cash flow from operations, the results of these types of studies may not be the same if a truer measure of cash flow had been used.

A criticism of Largay and Stickney's study is that no formal statistical tests were performed. An additional criticism is that since only one firm was analyzed, the results cannot be generalized. However, the graphic analysis does indicate that the persistently small and negative amounts of cash flow generated from operations could have served as an early warning whereas the larger, positive amounts of working capital from operations and net income may not have readily pointed to problems. The graphic analysis also illustrates that W. T. Grant's working

capital from operations was probably not a good proxy for its cash flow from operations.

Casey and Bartczak (1984)

While the Largay/Stickney analysis indicates that for W. T. Grant Company cash flow from operations was a better predictor of firm failure than accrual accounting measures, Cornelius Casey and Norman Bartczak, in "Cash Flow--It's Not the Bottom Line" (1984), found otherwise. In their study of 60 failed and 230 nonfailed companies, they compared the ability of each of three operating cash flow measures (operating cash flow, operating cash flow divided by current liabilities, and operating cash flow divided by total liabilities) to the ability of a group of six accrual measures to discriminate between failed and nonfailed firms. The six accrual measures consisted of net income divided by total assets, cash divided by total assets, current assets divided by current liabilities, net sales divided by current assets, current assets divided by total assets, and total liabilities divided by owners' equity.

By using a separate discriminant analysis model for each operating cash flow variable, the authors found that the operating cash flow measures did accurately classify bankrupt firms. The operating cash flow variable was 90% accurate in classifying bankrupt firms; the operating cash flow divided by current liabilities variable was 83% accurate; and the operating cash flow divided by total liabilities variable was 82% accurate in classifying

bankrupt firms in the year prior to bankruptcy. The cash flow measures, however, were unable to classify nonbankrupt firms accurately. The operating cash flow variable was only 53% accurate; the operating cash flow divided by current liabilities variable was 73% accurate; and the operating cash flow divided by total liabilities variable was 69% accurate in classifying nonbankrupt firms in the year prior to bankruptcy.

Casey and Bartczak then used a multiple discriminant analysis model consisting of all six accrual measures. They found that this model did accurately classify both bankrupt (83% accurate) and nonbankrupt (87% accurate) firms. From their results, the authors surmise that accrual measures are more effective than cash flow measures in predicting bankruptcy.

A weakness of this study, however, is the comparison of the results of univariate models to the results of a multivariate model. Any expected differences due to differences in the models were not discussed. Nevertheless, by illustrating that the model of accrual variables are better predictors of firm failure than each of the cash flow variables, this study does question the advantage posited by Largay and Stickney of using cash flow from operations to predict bankruptcy.

The results of additional tests of the marginal ability of cash flow variables to predict firm failure were also reported in "Cash Flow--It's Not the Bottom Line." Casey

and Bartczak found that the addition of each cash flow variable to the discriminant model of accrual measures did not significantly improve the ability of the model to predict firm failure. In summarizing the results of their study, the authors questioned,

Our finding that OCF (operating cash flow) data do not accurately distinguish between healthy companies and dying ones raises a question about the presumed value of cash flow data for analyzing and forecasting a company's performance (p. 65).

Casey and Bartczak (1985)

In the study, "Using Operating Cash Flow Data To Predict Financial Distress: Some Extensions," Casey and Bartczak (1985) reported the results of further tests of the marginal ability of cash flow variables to predict firm failure. They used the same data from their earlier study in both a multiple discriminant model and a logit model. They found that none of the cash flow variables tested improved the ability of the accrual variables to predict firm failure.

Gentry, Newbold, and Whitford (Spring, 1985)

James Gentry, Paul Newbold, and David Whitford, in "Classifying Bankrupt Firms with Funds Flow Components" (Spring, 1985), investigated the ability of seven funds flow components to predict firm bankruptcy. The funds flow components consisted of operating net income adjusted for depreciation and amortization expense, working capital from operations, funds flow from financing activities (proceeds of borrowing or payments of loan principal), fixed coverage

expenses (interest and lease payments), capital expenditures, dividends, and changes in other assets and liabilities. Each of these components was divided by the total flow of funds which was computed by either totaling all the cash inflows plus a positive change in cash from the statement of changes in financial position or by totaling all of the cash outflows plus a negative change in cash. Since the absolute values of these two amounts must always be equal, the absolute value of either amount can be used. An additional variable produced by dividing the total flow of funds by total assets was also used so that the model consisted of the seven funds flow variables and total flow of funds divided by total assets.

Gentry et al., applied multiple discriminant analysis, probit, and logit techniques to their model by using matched pairs of 33 failed and 33 nonfailed firms as well as matched pairs of 23 financially weak and 23 not financially weak firms. Their model correctly classified 77% to 83% of the failed/nonfailed companies and 70% to 78% of the weak/nonweak companies. The authors then included cash flow from operations in their model.

Similar to the results of Casey and Bartczak, Gentry et al., found that the addition of cash flow from operations did not improve the predictive ability of their model. Since both the study by Casey and Bartczak (1985) and the study by Gentry et al. (Spring, 1985) indicate that cash accounting measures are often unable to improve the ability

of accrual accounting measures to predict firm failure, the assumption that cash flow from operations is a more useful measure than an accrual operating funds flow measure is questioned.

Summary

The results of these firm failure studies indicate that accrual measures are usually more effective in predicting financial distress than cash flow measures. These findings question the demands for operating cash flow data to the exclusion of accrual measures of funds flow from operations. More empirical research is needed, however, to determine the situations in which each type of measure is more useful. Although these studies found that accrual measures are usually better able to predict firm failure than cash measures, Largay and Stickney's study illustrates that cash flow measures may be better predictors in some cases. Further, since the predictive abilities of the two types of measures differ, these studies also provide evidence that the properties of the two types of measures are most likely dissimilar.

Prediction of Future Cash Flow

This section discusses four research studies that have tested the relative abilities of cash accounting measures and accrual accounting measures to predict future cash flow from operations. The results of all four studies indicate that, for the majority of firms, accrual accounting measures are more useful in predicting future cash flow than cash

accounting measures. The studies also indicate, however, that cash accounting measures do contain some information useful to the prediction of future cash flow and that for some firms, cash accounting measures may be able to predict future cash flow better than accrual accounting measures.

Greenberg, Johnson, and Ramesh (1986)

A research study, "Earnings Versus Cash Flow as a Predictor of Future Cash Flow," by Robert Greenberg, Glen Johnson, and K. Ramesh (1986) compared the ability of cash flow from operations versus earnings before extraordinary items and discontinued operations of 157 firms to predict future cash flow from operations. Since part of the data used in this study was from years prior to 1971, the operating cash flow measure was computed by adjusting earnings for noncash items and changes in current accounts, except cash and the current portion of long-term debt. Two separate ordinary least squares regression models were applied to each firm over the 19-year period from 1964 through 1982. In one model, the relationship between earnings and future cash flow from operations was determined for each firm. In the other model, the relationship between cash flow from operations and future cash flow from operations was determined for each firm.

The coefficients of determination (r^2) produced by both models were compared to determine whether earnings or cash flow from operations was the better predictor of future cash flow from operations for each firm. Greenberg et al., found

that, after eliminating firms with autocorrelated data, 70 of the remaining 106 firms had a larger coefficient of determination by using the earnings model than by using the cash flow model to predict the next year's cash flow from operations. In additional analyses predicting each of two, three, four, and five years of future cash flows, the majority of firms had a larger coefficient of determination with the earnings model than with the cash flow model. These results indicate that accrual net income before extraordinary items and discontinued operations is a better predictor of future cash flow than cash flow from operations.

A weakness in this study is that the authors did not explain whether the difference between the r^2 's was significant, as determined by a statistical test. Further, while the results of this study may indicate that earnings is, in general, a better predictor of future cash flow than cash flow from operations, these results do not indicate that earnings is the better predictor in all cases. Cash flow from operations may be the better predictor for approximately one-third of the firms for which earnings was not considered better.

Bowen, Burgstahler, and Daley (1986)

The relative ability of cash flow variables versus accrual variables to predict future cash flow was also investigated by Robert Bowen, David Burgstahler, and Lane Daley in their study, "Evidence on the Relationships Between

Earnings and Various Measures of Cash Flow" (1986). From data gathered for 324 firms over a ten-year period (1971-1981), the authors tested the ability of each of four variables to predict future cash flow for each of one and two years into the future. The four predictor variables were net income before extraordinary items and discontinued operations, net income before extraordinary items and discontinued operations adjusted for depreciation and amortization charges, working capital from operations as reported on the statement of changes in financial position, and cash flow from operations (computed by adjusting working capital from operations by changes in current accounts other than notes payable and the current portion of long-term debt).

A separate simple linear model was used for each predictor variable for each year. The median absolute forecast error produced by each model was ranked each year. The ranks were then averaged across years, and this average was used to determine which variable was the best predictor of future cash flow. Net income adjusted for depreciation and amortization was found to be the best predictor of future cash flow followed closely by working capital from operations. Both were considerably better predictors than either cash flow from operations or net income. Pairwise sign tests of these predictor variables further supported the authors' conclusions.

Similar to Greenberg et al., these results indicate that accrual measures are generally able to predict future cash flow better than cash flow measures. However, again, this study did not suggest that the accrual variables always predicted future cash flow better. In some cases, cash flow from operations may have been the better predictor of future cash flow.

Costigan (1985)

To evaluate the ability of cash flow from operations to predict future cash flow, Michael Costigan, in his dissertation "The Marginal Predictive Ability of Accrual Accounting Information with Respect to Future Cash Flows from Operations" (1985), used a cross-sectional, time series model. The data used were from 85 firms, representing four industries, for a period of 20 years (1962-1982). The cash flow from operations variable was computed by adjusting earnings before extraordinary items and discontinued operations by noncash items and by changes in noncash current accounts.

From the results of the time-series model, Costigan suggests that cash flow from operations contains some information about the future cash flow of a firm. However, the addition of accrual components from each of working capital from operations and earnings before depreciation provided additional information with respect to future cash flow from operations. An earnings component was also tested

but was found to improve the effectiveness of cash flow from operations in predicting future cash flow only marginally.

The working capital from operations component was computed by taking the difference between cash flow from operations and working capital from operations. Similarly, the earnings adjusted for depreciation component was the difference between cash flow from operations and earnings before depreciation. The earnings component was also computed as the difference between cash flow from operations and earnings (52-53). Costigan tested whether each of these three accrual components could explain the remaining portion of future cash flow that was unexplained by the cash flow time series model. Because of the additional explanatory power provided by both the working capital component and the earnings before depreciation component, Costigan proposed that these accrual accounting measures are better able to predict future cash flow than cash flow from operations.

A criticism of this study is that the sample size used was quite small. However, the study does reveal the importance of accrual measures to the prediction of future cash flow. It also points out that past cash flow does have some information content useful to the prediction of future cash flow.

Fisher (1980)

Another dissertation, "Net Income as an Indicator of Future Net Cash Inflows from Operations" by John Fisher (1980), tested for explanatory relationships between seven

funds flow measures and future cash flow from operations. The seven measures were net income, earnings before extraordinary items and discontinued operations, earnings after extraordinary items and discontinued operations, working capital from operations, quick assets from operations, net income adjusted for depreciation, and cash flow from operations. Data were gathered from fifty firms over the thirty-year period from 1946 through 1975. Seven separate regression models were computed for each firm. Future cash flow was the dependent variable in each model, and each of the seven funds flow measures of operations was the independent variable in each of the seven models. A coefficient of determination was produced by the models and used to measure the strength of the relationship between future cash flow from operations and each of the independent variables.

Then, the strength of the relationship between future cash flow from operations and cash flow from operations was compared to the strength of the relationship of future cash flow from operations and each of the other independent variables. Fisher found that more firms had a larger coefficient of determination when each of the other six funds flow measures were used than when cash flow from operations was used as the predictor variable. From these results, the six accrual measures appear to be better able to predict future cash flow from operations than past cash flow from operations for the majority of firms.

A weakness in this study is the small sample size used. Additionally, no statistical tests were performed to measure the significance of the difference between individual firm r^2 's. Nevertheless, Fisher's study does provide additional evidence in the determination of which type of measure--cash or accrual--is better in predicting future cash flow. Apparently, accrual measures are better in most cases. Yet, since cash flow from operations appears to be the better predictor in some cases, the accrual measures cannot always be considered more effective predictors than cash measures.

Summary

As in the firm failure studies, these studies predicting future cash flow found that accrual measures are usually more effective predictors of future cash flow than cash measures. These findings, then, likewise challenge the wisdom of demanding cash flow from operations rather than allowing an optional funds flow measure to be reported. Because neither these studies nor the firm failure studies attempted to clarify the specific situations in which each type of measure would be more useful, additional research is needed to provide insight in clarifying the value of each type of measure in different circumstances.

Comparisons of Cash and Accrual Accounting Properties

Although prior research has been inconclusive in determining whether cash flow variables or accrual variables are always the better predictors of future events, prior research has provided evidence that the two types of

measures are probably different. In as much as accrual and cash measures differed in their abilities to predict future events, their properties must differ also. For the most part, the studies examined in this section agree that the two measures are different. However, results of some of the tests performed in these studies indicate that in some instances, differences between the two measures may not be so distinct.

Gombola and Ketz (January 1983)

Michael Gombola and J. Edward Ketz, in "A Note on Cash Flow and Classification Patterns of Financial Ratios," (January 1983) found that, contrary to earlier research,² cash flow ratios contain separate information not found in other financial ratios. The reason for the difference with earlier research, the authors suggest, is that earlier research computed cash flow from operations by simply adjusting net income for depreciation and amortization charges. Because Gombola and Ketz's computation of cash flow from operations (working capital from operations adjusted for changes in noncash current accounts) more nearly approximates actual cash flow from operations, their findings provide evidence that cash flow from operations contains information different than that included in other financial statement measures.

Gombola and Ketz applied factor analysis to forty financial ratios, including four cash flow ratios (cash flow divided by equity, cash flow divided by sales, cash flow

divided by total assets, and cash flow divided by total debt). These ratios were obtained from 119 firms over the 19-year period 1962 through 1980. For twelve of the nineteen years, the four cash flow ratios loaded on a distinctly separate factor. These results indicate that the cash flow ratios contained properties different from the properties of the other ratios used.

A weakness in this study is that only a small sample of firms was used. Further, in the years in which a distinctly separate cash flow factor was not formed, the cash flow variables must have contained properties similar to those contained in other ratios. Nevertheless, these results do indicate that the cash flow ratios were usually distinctly different from the other ratios included in the study.

Gombola and Ketz (1981)

Conflicting results were reported in an earlier study by Gombola and Ketz, "Alternative Measures of Cash Flow, Part II" (1981). Two tests (Kendall's distribution-free test for independence and the t-test) were used to measure the degree of similarity between cash flow from operations and each of net income, net income plus depreciation and working capital from operations. Data from 1976 were gathered for a total of 130 firms, divided into three groups. The three groups were comprised of a random sample of 100 firms, 15 firms whose accruals and deferrals were expected to be large, and 15 firms whose accruals and deferrals were expected to be small.

For the randomly selected group, cash flow from operations was found to be significantly different from both net income and net income plus depreciation. However, the difference between cash flow from operations and working capital from operations was not significant. These results indicate that for the random group of firms cash flow from operations contains information different than net income and net income plus depreciation. The cash flow from operations information, however, is not significantly different from the information provided by working capital from operations.

Although results using the group of large effect firms was similar to the results of the random group, results of the small effect firms were quite different. For the small effect firms, none of the differences between cash flow from operations and the other three measures of operations was statistically significant. From these results, information included in the cash flow of the small effect firms is apparently similar to the information included in the other three operating measures.

This study can be criticized for the small number of firms analyzed and the fact that data for only one year was used. Although the results indicate that cash flow from operations was usually quite different from both net income and net income adjusted for depreciation and amortization, they also indicate that cash flow was usually similar to working capital from operations. Moreover, these results

indicate that the properties of these measures differed across the different types of firms tested. Thus, cash flow from operations cannot be considered similar to or different from the other measures of operations in all cases.

Drtna and Largay (1985)

Ralph Drtna and James Largay, III, in "Reporting Cash Flows and Estimating Distributable Funds: Some Preliminary Results" (1985), also found that differences in cash flow from operations and working capital provided by operations were not significant. They used the Wilcoxon matched-pairs signed-ranks test and the paired t-tests to analyze differences between three variables--income from continuing operations, working capital from operations, and cash flow from operations for each firm. Data obtained from 29 firms over four years (1979-1982) were used to compute the variables. The authors found that although cash flow from operations was significantly different from income, it was not significantly different from working capital from operations.

This study can also be criticized for its small sample size. A further criticism can be levied due to only four years being analyzed. Yet, since its results are similar to those of Gombola and Ketz (1981), they provide additional evidence that cash flow from operations differs from income but is similar to working capital from operations.

Gombola and Ketz (September-October, 1983)

Gombola and Ketz, in "A Caveat on Measuring Cash Flow and Solvency" (September-October, 1983), report conflicting evidence. In this study, seven measures of the operating results of 597 companies for an 18-year period (1960-1977) were computed. The seven measures were net income, net income before extraordinary items, net income plus depreciation, net income before extraordinary items plus depreciation, working capital from operations, net quick assets from operations, and cash flow from operations. Each of these measures was divided by total assets. Correlation analysis was used to determine if any one of the seven measures was highly correlated with any of the other six measures. Results of the correlation analyses indicated that cash flow from operations was highly correlated with net quick assets from operations. Cash flow from operations was not highly correlated with any of the other measures.

The results of this study conflict with those of both Drtina and Largay (1985) as well as Gombola and Ketz (1981). Since the sample size of this study was considerably larger than either of those studies and a much greater number of years was analyzed, its results can be considered more reliable. However, the studies by Drtina and Largay (1985) and by Gombola and Ketz (1981) still provide evidence that, in some instances, cash flow from operations is similar to other measures of operations.

Bowen, Burgstahler, and Daley (1986)

In addition to measuring the ability of their four variables to predict future cash flow as summarized earlier, Bowen, Burgstahler, and Daley in "Evidence on the Relationship Between Earnings and Various Measures of Cash Flow" (1986), measured correlations between pairs of the variables. They tested both the first differences as well as the percentage changes of the variables. None of the correlations between cash flow from operations and either net income adjusted for depreciation and amortization expenses, or operating income adjusted for depreciation and amortization expenses, or working capital from operations were large. The largest correlation was .444 between the first differences of cash flow and working capital from operations. These results further affirm the findings of Gombola and Ketz (September-October, 1983).

Thode, Drtina, and Largay (1986)

Stephen Thode, Ralph Drtina, and James Largay III in "Operating Cash Flows: A Growing Need for Separate Reporting" (1986), also tested the relationship between cash flow from operations and other operating measures. Using a ten-year period (1973-1982), they examined the net income from continuing operations, the working capital provided by operations, and the cash flow from operations of all of the companies included in Standard and Poor's 400 Industrials Index. Due to some data items not being reported, the sample size varied over the years from 375 firms to 400

firms. They tested twelve hypothesized relationships by using t-tests, Wilcoxon signed-ranks tests, and cross-sectional linear regression.

Results of the regression analyses indicate that no linear relationship exists between cash flow from operations and working capital from operations. The results of their other tests indicate that the dollar amounts of cash flows from operations are different from the dollar amounts of working capital provided by operations and net income from continuing operations. However, their tests of annual changes in these variables did not provide clear evidence of differences between them.

These results, for the most part, support the findings of the studies by Bowen et al. (1986) and by Gombola and Ketz (September-October 1983). However, the lack of solid differences between the year-to-year changes in cash flow and working capital from operations is similar to the results found by Gombola and Ketz (1981) and by Drtina and Largay (1985). These findings, then, suggest that cash flow from operations may not be different from other measures of operations in all cases.

Summary

Similar to the results of studies exploring the predictive ability of cash accounting measures versus accrual accounting measures, the results of current research comparing the properties of cash accounting data and accrual accounting data have produced conflicting evidence. The

predictive supremacy of one basis over the other is questionable if both bases contain essentially the same information, and these results have not conclusively proven otherwise. From this, one type of measure may be found more useful in one situation while the other type of measure is more useful in a different situation, and the measures may be found equally useful in a still different situation.

Research of Industry Effects

The conflicting and inconclusive results reported in studies comparing operating cash flow to accrual accounting measures indicate the presence of other factors which are also influencing these results. One possible factor which has been found significant in other research is that of industry effects. Research into the effects of differences in industry has found that industry type influences the relationship among a firm's variables and the variations in a firm's stock returns, its systematic risk, and its earnings (See end note 4 in Chapter One).

Costigan (1985)

Research investigating the ability of accounting measures to predict future cash flow has found that differences in industry classification influence this ability. As discussed earlier, Costigan (1985) tested the ability of each of a working capital component, an earnings before depreciation component, and an earnings component to provide marginal information, over that already provided by past cash flow, with respect to explaining variations in

future cash flow across four industries. The four industries tested were comprised of 15 firms in the drug industry, 24 firms in the steel industry, 14 firms in the air industry, and 12 firms in the retail industry.

Results of his tests indicate that each of these accrual components was able to provide additional information useful in explaining variations in the future cash flow from operations of firms in different industries. However, differences across industries were found in the extent of additional information the three accrual components were able to provide. The working capital component improved the prediction of future cash flow in all four industries. The earnings before depreciation component improved the prediction of future cash flow in all of the industries except the air industry. The earnings component improved the prediction of future cash flow in the retail industry only.

The findings of this study indicate that the effectiveness of these accrual variables in predicting future cash flow is affected by industry type. These findings are consistent with those of other research studies that industry effects are important. In this study, industry effects help to explain why a cash accounting variable may be more useful in one situation while an accrual variable is more useful in a different situation.

Gombola and Ketz (1981)

The 1981 study by Gombola and Ketz, summarized earlier, also substantiates the importance of industry effects. The authors used t-tests to analyze the relationships between cash flow from operations and each of working capital from operations, net income before depreciation, and net income. These analyses were performed for each of three groups of firms consisting of 15 firms in industries whose accruals and deferrals are expected to be large, 15 firms in industries whose accruals and deferrals are expected to be small, and 100 randomly selected firms. Results of the t-tests indicate that the relationships between cash flow from operations and each of the other three accounting measures differ across industries.

These findings indicate that the difference between net income and cash flow from operations is significant in the randomly selected firms and in the large effect firms but not significant in the small effect firms. The difference between net income plus depreciation and cash flow from operations is significant in the randomly selected firms, somewhat significant (alpha of .066) for the large effect firms, and insignificant in the small effect firms. No significant difference was found between working capital from operations and cash flow from operations in the randomly selected firms, but the difference was found to be somewhat significant in the other two groups of firms--alpha

of .06 for the large effect firms and alpha of .085 for the small effect firms.

These results provide further evidence of the existence of and importance of industry effects with respect to the relationship between accrual accounting measures and cash accounting measures. The results suggest that industry effects are partially responsible for differences in the results of tests comparing cash accounting and accrual accounting measures. Thus, industry effects may also be useful in explaining inconsistencies in the abilities of cash and accrual accounting measures to predict future events.

Summary

Extant research of the predictive ability of accounting measures, then, indicates that additional factors are present which affect the abilities of various accounting measures to predict future events. Further, research into industry type points to the likelihood that industry effect is an important cause of variations in the predictive ability of accounting measures. However, these earlier findings only suggest that differences exist in the abilities of various funds flow concepts to predict future cash flow across industries. The results of tests to be conducted in this study will provide evidence of whether different concepts of operating funds flow actually are better predictors of future cash flow for different industries as theoretically expected.

The need for additional empirical tests of the ability of cash flow data to forecast a firm's performance was discussed by Casey and Bartczak (1984). In their challenge of the assumed usefulness of cash flow data, they state,

Elevating cash, without testing its applicability, as the panacea for the problem of assessing performance is akin to the euphoria in the 1960s surrounding growth in earnings per share as supposedly the best indicator of company value. We hope that unbridled enthusiasm for cash flow data will not produce a repeat of the debacles that resulted from blindly following earnings-per-share-growth (p. 65)

As this quotation suggests, the literature review has revealed several questions that require further investigation.

This study will investigate three of those questions. The first question of which funds flow measure--cash, net quick assets, or working capital--is the most accurate predictor of future cash flow has been examined in earlier studies. The results of this study, using different methodology and data, will either further substantiate or dispute the earlier findings that working capital from operations predicts future cash flow better than either cash flow from operations or net quick assets from operations.

The second question of whether industry effects will cause variations in the abilities of the three funds flow measures to predict future cash flow has been tested to a limited extent. Costigan (1985) found that the ability of a working capital component to improve the prediction of

future cash flow did differ across industries. However, the literature review revealed no studies that tested differences in effectiveness of each of cash flow from operations, net quick assets from operations, and working capital from operations in predicting future cash flow across industries.

Similarly, a review of the literature revealed no studies that addressed the third question to be investigated in this study. This question asks whether industry characteristics influence the effectiveness of each of the three funds flow measures in predicting future cash flow as a priori expected. The following chapter will describe procedures that this study will use to help resolve these three research questions.

End Notes

¹For example, see Ball and Brown, 1968; Beaver and Dukes, 1972; Beaver, 1966 and 1968, Deakin, 1972; Blum, 1974.

²For example, Pinches et al., 1973 and Pinches et al., 1975 found that their cash flow ratios loaded on a factor containing earnings ratios. Their cash flow numbers, however, were computed by simply adjusting net income for depreciation and amortization expenses.

CHAPTER THREE

RESEARCH METHODOLOGY

Discussed in this chapter is the methodology that is used to explore the research questions enumerated in the first chapter. First, the hypotheses are developed from a priori expectations. These expectations are based on results of prior research examined in the first two chapters and on theoretical analyses developed in the first chapter. Other methodological procedures are then presented including the selection of the firms and the time period of interest in this research. The methods and variables that were used to group the firms for analyses and for determination of expected results are discussed. These variables and the models used are described in detail; and, lastly, the a priori expectations are explained.

Hypotheses

Comparison of Overall Predictive Ability

The first research question is:

Among the operating funds flow measures of cash, net quick assets, and working capital, which is the most accurate predictor of future cash flow?

In order to test all possible results, the null hypotheses were stated in pairs. The testing of two null hypotheses, instead of one, increases the probability that type 1 error (rejection of the null hypothesis when, in fact, it is true) will occur. To reduce this probability, a smaller alpha level was used.

Results of prior research indicate that accrual measures of operations are more accurate in predicting future cash flow than cash-based measures of operations (Greenberg et al., 1986; Bowen et al., 1986; Costigan, 1985; Fisher, 1980). Since working capital from operations is based on accrual accounting to a greater extent than both net quick assets from operations and cash flow from operations, the a priori expectation is that working capital from operations will prove more accurate in predicting future cash flow than either of the other two measures. The first two pairs of null hypotheses test this expected result.

- H1A: Working capital from operations is no more accurate in predicting future cash flow from operations than net quick assets from operations.
- H1B: Net quick assets from operations is no more accurate in predicting future cash flow from operations than working capital from operations.
- H2A: Working capital from operations is no more accurate in predicting future cash flow from operations than cash flow from operations.
- H2B: Cash flow from operations is no more accurate in predicting future cash flow from operations than working capital from operations.

Rejection of both primary hypotheses H1A and H2A will indicate that of the three funds flow measures, working capital from operations is most effective in predicting future cash flow. If H1A and H2A are rejected, working capital from operations will be considered the most accurate predictor, and the subhypotheses H1B and H2B can be ignored.

Failure to reject primary H1A along with rejection of primary H2A will indicate that the ability of net quick assets from operations to predict future cash flow is either better than or not significantly better than that of working capital from operations and that both are better predictors than cash flow from operations. In this situation H1B must be tested while H2B can be ignored. If H1B is rejected, net quick assets from operations will be considered the best predictor of future cash flow. Failure to reject H1B will result in working capital from operations and net quick assets from operations being considered not significantly different in their abilities to predict future cash flow and both being considered better predictors than cash flow from operations.

A similar analysis can be applied to the situation in which primary H1A is rejected along with failure to reject primary H2A. In this event, the subhypothesis H2B must be tested while H1B can be ignored. Rejection of H2B will indicate that cash flow from operations is the best predictor of future cash flow. If H2B cannot be rejected, working capital from operations and cash flow from

operations will be deemed not significantly different in their abilities to predict future cash flow, and both will be deemed better predictors than net quick assets from operations.

The fourth possible result of testing the primary hypotheses H1A and H2A is that neither will be rejected. In this case four possibilities exist: (1) no significant differences exist in the effectiveness with which the three operating funds flow measures predict future cash flow; (2) net quick assets from operations and cash flow from operations are not significantly different in their predictive effectiveness with both being better than working capital from operations; (3) net quick assets from operations is the best predictor of future cash flow; (4) cash flow from operations is the best predictor of future cash flow. This situation will require that both subhypotheses H1B and H2B be tested.

Rejection of H1B along with failure to reject H2B will indicate that net quick assets from operations is the best predictor of future cash flow. Conversely, failure to reject H1B along with rejection of H2B will mean that cash flow from operations is the best predictor of future cash flow. Failure to reject both H1B and H2B will indicate that the effectiveness with which working capital from operations predicts future cash flow is not significantly different from either net quick assets from operations or cash flow from operations.

The rejection of both H1B and H2B after failure to reject both primary hypotheses H1A and H2A will imply that working capital from operations is least effective in predicting future cash flow. However, three possibilities remain: (1) net quick assets from operations and cash flow from operations are not significantly different in the effectiveness with which they predict future cash flow with both being better than working capital from operations; (2) net quick assets from operations is the best predictor of future cash flow; (3) cash flow from operations is the best predictor of future cash flow. This situation will require further analyses in order to determine which of the three operating funds flow measures is the best predictor of future cash flow.

If this situation is found to be the case, a third pair of hypotheses must be considered. This third pair of hypotheses is as follows:

H3A: Net quick assets from operations is no more accurate in predicting future cash flow from operations than cash flow from operations.

H3B: Cash flow from operations is no more accurate in predicting future cash flow from operations than net quick assets from operations.

If primary H3A is rejected after failure to reject primary H1A and H2A and rejection of subhypotheses H1B and H2B, net quick assets from operations will be judged the best predictor of future cash flow, and a test of H3B can be omitted.

However, failure to reject all three primary hypotheses along with rejection of subhypotheses H1B and H2B will indicate the existence of two possibilities: (1) net quick assets from operations and cash flow from operations are equally effective predictors with both being better than working capital from operations; (2) cash flow from operations is the best predictor of future cash flow. A test of the subhypothesis H3B is needed to determine which of these two possibilities is the case. If H3B is rejected, cash flow from operations will be regarded as the best predictor of future cash flow. Alternatively, failure to reject H3B will indicate that the predictive abilities of net quick assets from operations and cash flow from operations are not significantly different with both being better than working capital from operations.

Analysis of Industry Effects

Hypotheses H4, H5, and H6 test the second research question, which is:

Is the effectiveness of the operating funds flow measures of cash, net quick assets, and working capital in predicting future cash flow the same across industries?

Several earlier studies have established the existence of and the importance of industry effects.¹

Other studies comparing the ability of accrual accounting variables (such as working capital from operations) and cash accounting variables (such as net quick assets from operations and cash flow from operations) to predict firm failure have produced conflicting results which

may be explained, in part, by the influences of industry factors (Largay and Stickney, 1980; Gentry et al., September-October, 1985 and Spring, 1985; Casey and Bartczak, 1984 and 1985). Inconclusive results, possibly due to industry factors, were also found in studies attempting to determine whether accrual measures and cash-based measures contain essentially the same properties (Gombola and Ketz, 1981, September-October, 1983, and January, 1983; Drtina and Largay, 1985; Bowen et al., 1986; Thode et al., 1986).

These results lead to a priori expectations that the effectiveness of the variables used in this study to predict future cash flow will differ across industries. Hypotheses H4, H5, and H6 test these expected results.

- H4: The effectiveness of cash flow from operations in predicting future cash flow does not differ across industries.
- H5: The effectiveness of net quick assets from operations in predicting future cash flow does not differ across industries.
- H6: The effectiveness of working capital from operations in predicting future cash flow does not differ across industries.

Rejection of hypotheses H4, H5, and H6 will suggest that industry factors affect the ability of each of the funds flow measures to predict future cash flow. However, failure to reject these hypotheses will mean that no evidence was found to indicate that industry factors do affect the predictive ability of these three operating funds flow measures.

Analysis of Company Characteristics

Hypotheses H7, H8, and H9 test the third research question, which is:

Do company characteristics influence the effectiveness of the three operating funds flow measures in predicting future cash flow as a priori expected?

A priori expectations, developed in Chapter One, are that of the three operating funds flow measures, cash flow from operations will be the most effective in predicting future cash flow for companies that maintain relatively small amounts of receivables, payables, and inventory; net quick assets from operations will be the most effective predictor for companies that maintain relatively large amounts of receivables and payables but small amounts of inventory; and working capital from operations will be most effective for companies that maintain relatively large levels of inventory. Since prior research has not examined these relationships, the a priori expectations are those developed in Chapter One. Hypotheses H7, H8, and H9 are designed to test these expected results.

H7: Cash flow from operations is no more effective in predicting future cash flow for companies that maintain relatively small amounts of receivables, payables, and inventory than either net quick assets from operations or working capital from operations.

H8: Net quick assets from operations is no more effective in predicting future cash flow for companies that maintain relatively large amounts of receivables and payables but low levels of inventory than either cash flow from operations or working capital from operations.

H9: Working capital from operations is no more effective in predicting future cash flow for companies that maintain relatively large amounts of inventory than either cash flow from operations or net quick assets from operations.

Rejection of all three hypotheses H7, H8, and H9 will provide evidence that the actual predictive ability of each of the three funds flow measures is affected by differences in a particular company's asset composition as expected. Conversely, the failure to reject all three hypotheses will mean that the a priori expectations cannot be supported.

Selection of Firms

The 454 firms examined in this study are drawn from all firms available from the Compustat file of industrial companies for the eleven-year period from 1975 through 1985. Although this file contains over 3,000 companies, many companies could not be used because of missing information, mergers, acquisitions, dissolutions, or the firm's use of the last in, first out (LIFO) inventory valuation method. All firms meeting the following requirements were included:

1. The firm must be included on the Compustat tape for the entire eleven-year period.
2. The firm must have complete data needed for this study for each of the eleven years.
3. The firm must not have switched industry classification during this eleven-year period.
4. The firm must not have merged with or acquired other firms during this eleven-year period.
5. The firm must not have used LIFO as the predominant method of valuing its inventory during this eleven-year period.

In order to increase the sample size, other sources including Moody's manuals and Standard and Poor's Stock Reports were consulted to supply missing data for eleven of the sixteen firms with missing data items.

The first two requirements ensured that all the data items necessary to estimate the relationships were available. The third requirement was necessary for the industry analysis to ensure that each firm used was continuously in the same industry. Further, since acquisitions and mergers cause changes in working capital accounts other than through the results of operations, the fourth requirement was needed.

The fifth requirement was also needed in this study because of the a priori expectation that inventory size has a significant effect on a firm's ability to generate cash flows in the following year. The value of inventories of firms using the LIFO inventory valuation method is based on dollar values of prior years while firms using other inventory valuation methods are all using values based on the current year's dollars. Therefore, the inventory values of LIFO firms are not comparable to inventory values of firms using other inventory valuation methods. Moreover, firms using LIFO do not all use the same base year. Thus, inventory values are not comparable between LIFO firms and firms using other valuation methods, nor are inventory figures comparable among the LIFO firms.

Time Period

The time period used in this examination was the most recent ten years of information available on Compustat, from 1976 through 1985. However, data were also gathered for 1975 because the amount of change in some items from the eleventh year to the tenth year was needed to compute values of the variables. Funds flow data and the data needed to convert to the three funds flow concepts are available on Compustat only after 1971. For years prior to 1971, this data would have to be approximated. However, the approximation of this data was found by Bowen, Burgstahler, and Daley (1986) to introduce error.² Since the data was available for the time period used in this study, it was not necessary to approximate most data.

The use of a ten-year time period allowed a relatively large number of firms (454) to be retained in the study. Studies using longer periods of time must eliminate more firms because problems such as missing information, mergers, acquisitions, and dissolutions increase. For example, Greenberg et al. (1986), used a nineteen-year period and were able to retain only 157 firms in their study while Bowen et al. (1986), using a ten-year period, were able to retain 324 firms.

Further, using the most recent ten-year period allows the inclusion of only the most current data and trends. Since older data may no longer be relevant, its inclusion may unnecessarily bias the regression estimators. Use of

more current data may provide more realistic estimates of future cash flow for comparison with actual future cash flow.

The trade-off in this study is common to many studies using time series data. A greater number of years can be used to improve the reliability of the regression estimators; however, doing so reduces the number of firms which may be examined. Alternatively, a shorter time period allows a larger number of firms to be included in the study with more accurate and reliable data.

In this study more firms are needed, in particular, because of the division of the available firms into industry groups. By retaining a larger number of firms, fifteen industries containing between ten and seventy firms each can be analyzed. This number of industries and firms is larger than those analyzed in earlier studies of industry effects.³

Firm Grouping and A Priori Expectations

In order to test the hypotheses of the third research question, the firms first had to be grouped according to similarities in the composition of their asset holdings. Two different methods were used to group the firms--cluster analysis and the two-digit SIC number. The firm groups produced by each method were then used separately in the hypotheses tests.

The cluster grouping was used to anticipate possible problems associated with grouping firms based on their SIC numbers. Although the two-digit SIC numbers are commonly used to group firms with similar characteristics, some problems are present in this type of grouping due to the diversification on many firms. A firm is classified by SIC number based on its predominant business activity. However, firms are often engaged in more than one type of business activity. Therefore, many differences may be found in firms classified with the same two-digit SIC number (Gupta et al., 1972; Foster, 1986). Since the asset holdings of firms with the same two-digit SIC number may not be similar, both cluster analysis and the two-digit SIC number were used to group the firms.

Cluster analysis groups observations by similarities in the data "such that objects in a given cluster tend to be similar to each other in some sense, and objects in different clusters tend to be dissimilar" (Statistical Analysis System: Statistics, 1982, p. 417). This procedure is useful for "finding a natural clustering among entities" where the grouping basis may not be readily apparent (Jensen, 1971, p. 50).

The natural clusters being sought in this study are based on the composition of current assets and current liabilities. The a priori expectations discussed above and in Chapter One are that differences in the levels of receivables, payables, and inventory compared to total

current assets are important factors in determining the effectiveness of the three funds flow measures in predicting future cash flow. As theorized in Chapter One, differences in the relative values of these current accounts with respect to current assets are expected to be more useful in determining differences in the predictive effectiveness of the three operating funds flow measures than their gross values because the composition of accounts within a firm's current assets and the portion of these current assets that is needed to satisfy current liabilities are expected to be determinants of which funds flow measure is the best predictor of future cash flow. Therefore, the three ratios consisting of receivables, payables, and inventory to total current assets for each firm were used in the cluster analysis. The ratios of receivables to total current assets and of inventory to total current assets produced variables which indicated the portion of current assets the receivables and the inventory represented. The ratio of payables to total current assets produced a variable which indicated what portion of current assets was needed to meet current obligations.

The relative variables were used in cluster analysis to group the firms. The resulting clusters represent firms that are most similar to each other in terms of the relative size of each of their receivables, payables, and inventory. For the clustered group of firms characterized by small amounts of receivables, payables and inventory, relative to total

current assets, cash flow from operations is expected to be the most effective in predicting future cash flow. Net quick assets from operations is expected to be the most effective predictor for the cluster characterized by large amounts of receivables and payables and small amounts of inventory relative to total current assets. The a priori expectation for the two clusters characterized by relatively large amounts of inventory is that working capital from operations will be the best predictor of future cash flow.

Firms were also grouped by their two-digit SIC numbers into industries to determine whether the a priori expectations could explain industry differences. For these tests industry averages were used to compute the three ratios, comprised of each of receivables, inventory, and payables to total current assets. Each industry's set of ratios were examined to determine the a priori expectation for that industry. Industries for which all three ratios are small are expected to find that cash flow from operations is the best predictor of future cash flow. In industries whose ratios of receivables and payables to total current assets are large but whose ratio of inventory to total current assets is small, net quick assets from operations is expected to be the best predictor of future cash flow. Working capital from operations is expected to be the best predictor of future cash flow in each industry whose ratio of inventory to total current assets is large.

The Variables

Three independent or predictor variables were used in this study--cash flow from operations, net quick assets from operations, and working capital from operations. The relationships between each of these three independent variables and one dependent or predicted variable--future cash flow from operations--were examined. The independent variables differ only with respect to current accounts. Since the cash flow from these current accounts is expected to be realized during the following accounting period, the future cash flow of interest is the following year's cash flow from operations. Each of the independent variables has been examined in prior research (Anton, 1962; Staubus, 1966; Fisher, 1980; Gombola and Ketz, September-October, 1983), and each can be considered as a possible best measure in the question of which funds flow measure will best predict future cash flow from operations.

The measures used as predictors either are reported in the statement of changes in financial position or can be computed from information included in both the statement of changes in financial position and the balance sheet. Compustat reports either working capital from operations or cash flow from operations as the funds flow measure for the statement of changes in financial position.

An examination of published financial statements revealed that the cash flow measure reported by Compustat was frequently incorrect. The 1984 and 1985 cash flow from

operations measure reported on Compustat by forty-seven firms was compared to the funds flow from operations measure reported by those firms in either Moody's manuals or Accounting Trends and Techniques. Only one of these firms correctly reported cash flow from operations on Compustat. The cash flow from operations measure reported on Compustat by the remaining forty-six firms is actually either working capital from operations or some other amount.

Prior research indicated no problems with Compustat's value of working capital from operations; and an informal comparison of working capital from operations reported by Compustat and that reported in Moody's manuals revealed no differences. Consequently, only working capital from operations reported by Compustat was accepted as an accurate measure. Where cash flow from operations was reported, computed working capital from operations was substituted as the operating funds flow measure. Working capital from operations was computed by adjusting net income before extraordinary items and discontinued operations by the income effects of depreciation and amortization, deferred taxes, and minority interest, and by subtracting the net change in current assets (excluding cash), and by adding the net change in current liabilities (excluding notes payable and the current portion of long-term debt). The operational formula used to compute working capital from operations is:

$$WCO_{it} = INB_{it} + DPR_{it} + DTX_{it} + MNI_{it} \quad (3.1)$$

where the i th firm reported cash flow from operations on Compustat in year t , and all other variables are defined in Table 3.1.

Moreover, an adjustment was also made to the working capital from operations measure reported by Compustat. Since Compustat includes the income effect of extraordinary items and discontinued operations in its computation of working capital from operations, this effect was removed. The computational formula needed to adjust reported working capital from operations, when (3.1) was not used, is as follows:

$$WCO_{it} = WCR_{it} - EXD_{it} \quad (3.2)$$

where the i th firm reported working capital from operations on Compustat in year t , and all other variables are defined in Table 3.1. After these adjustments were completed, working capital from operations became the operating funds flow measure for all of the firms for all of the years included in this study. The other two measures were computed by adjusting the working capital from operations measure.

Cash flow from operations was computed by adjusting working capital from operations by changes in non-cash current assets and changes in current liabilities (excluding notes payable and the current portion of long-term debt). As described in the FASB Exposure Draft, "Reporting Income, Cash Flows and Financial Position of Business Enterprises" (1981) and as used in prior research,⁴ notes payable and the

 TABLE 3.1

Identification of Symbols Used

CFO = cash flow from operations

QAO = net quick assets from operations

WCO = working capital from operations

Δ = amount of change in the item from year $t - 1$ to year t , computed as $\text{variable}_t - \text{variable}_{t-1}$

WCR = operating working capital flow reported by Compustat (110)

CA = current assets (4)

C = cash and short-term investments (1)

AR = accounts receivable (2)

CL = current liabilities (5)

CD = notes payable and the current portion of long-term debt (34)

EXD = extraordinary items and discontinued operations (124)

INB = income before extraordinary items and discontinued operations (18)

DPR = Depreciation and amortization expense (14)

DTX = deferred tax, income account (50)

MNI = minority interest, income account (49)

 **Compustat item numbers are in parentheses

current portion of long-term debt are excluded because they are considered financing activities rather than operating activities. The computational formula used to derive cash

flow from operations by adjusting working capital from operations is:

$$CFO_{it} = WCO_{it} - \Delta CA_{it} + \Delta C_{it} + \Delta CL_{it} - \Delta CD_{it} \quad (3.3)$$

where the variables are defined in Table 3.1.

Net quick assets from operations was derived from working capital from operations by excluding changes in current assets, except for cash, short-term investments, and accounts receivable. The formula for computing net quick assets from operations is:

$$QAO_{it} = WCO_{it} - \Delta CA_{it} + (\Delta C_{it} + \Delta AR_{it}) \quad (3.4)$$

where the variables are defined in Table 3.1.

The dependent or predicted variable is future cash flow from operations. This variable is computed exactly the same as cash flow from operations. The two variables differ only in that cash flow from operations is from year t , and future cash flow from operations is from year $t + 1$.

Models

Separate ordinary least squares regression models were used to test the relationship between the dependent variable, future cash flow from operations, and each of the independent variables--working capital from operations, net quick assets from operations, and cash flow from operations. These relationships were tested over the ten-year period using three different groups of firms: (1) all of the firms combined, (2) firms grouped by two-digit SIC numbers, and (3) firms grouped by clusters. The three models that were used for each group of firms are as follows:

$$\text{CFO}_{it} = a + b(\text{WCO}_{it-1}) + e_{it} \quad i = (1, \dots, n) \quad (3.5)$$

$$\text{CFO}_{it} = a + b(\text{QAO}_{it-1}) + e_{it} \quad i = (1, \dots, n) \quad (3.6)$$

$$\text{CFO}_{it} = a + b(\text{CFO}_{it-1}) + e_{it} \quad i = (1, \dots, n) \quad (3.7)$$

where:

n = number of companies

t = 1, . . . , 10 time periods

i = ith company

a = estimate of the intercept parameter

b = parameter estimate of the independent variable

e = error term.

Autocorrelation

The use of regression models to estimate these relationships assumes independence of the error terms. However, when time series data are used, this assumption is often violated, resulting in autocorrelation (serial correlation) of the error terms. When the error terms are autocorrelated, the coefficient of determination (r^2) will be misstated, the F-ratio and the t-statistics will be biased, and the parameter estimates will be unreliable. The researcher will be misled because the data will seem to be fitted by the regression equation more accurately than it actually is, and the true variances will be underestimated (Ostrom, 1978).

Two different tests were used to determine whether autocorrelation was present. The two-sided Durbin-Watson test was used for each model whose independent variable is either working capital from operations or net quick assets

from operations. This commonly used test can discover correlation (either positive or negative) between errors computed from one time period to the next. The test is called a two-sided test because a result falling on one side of its scale denotes negative autocorrelation while a result falling on the other side denotes positive autocorrelation (Ostrom, 1978).

However, the Durbin-Watson test is not appropriate for the model whose independent variable is cash flow from operations because the independent variable (CFO_{t-1}) is a lagged value of the dependent variable (CFO_t). In cases where the error term is autocorrelated and the independent variable is a lagged value of the dependent variable, the independent variable is now related to the error term. Because of this relationship, the independent variable will tend to absorb some of the systematic disturbance which would otherwise be reflected in the error term, and the actual magnitude of the autocorrelation will be underestimated. In these cases, the Durbin-Watson test will not always be able to detect autocorrelated error terms (Ostrom, 1978).

As alternatives to the Durbin-Watson test, two methods have been developed by Durbin to test for autocorrelation in models where the independent variable is a lagged value of the dependent variable. One test, which uses an h statistic, is appropriate for time periods in excess of thirty; therefore, it was not used in this research. The

other method, which was used in this study, first uses the original model to produce regression estimates of both this year's error term and the previous year's error term. A second regression is then performed using this year's estimated error term as the dependent variable. The independent variables consist of last year's original dependent variable, CFO, and last year's estimated error (from the first regression). The t-test is then used to determine if the resulting coefficient of last year's estimated error is statistically different from zero. If the coefficient is found to be significantly different from zero, the presence of autocorrelation is indicated. The formula used to test for autocorrelation where the independent variable is a lagged value of the dependent variable is (Ostrom, 1978, pp. 51-53):

$$\hat{\epsilon}_{it} = CFO_{it-1} + \hat{\epsilon}_{it-1} \quad (3.8)$$

where $\hat{\epsilon}$ is the estimated error from the original regression, and all other variables have been previously defined.

In the cases where autocorrelation is found, the original model alone is no longer appropriate for estimating the strength of the relationship between the dependent and the independent variables. However, by including information with respect to the pattern of the systematic variation in the original model, a better estimate of the relationship can be obtained (Ostrom, 1978). Two different equations were used to estimate the pattern of systematic variation. Where the independent variable is working

capital from operations or net quick assets from operations the following equation was used (Ostrom, 1978, p. 39):

$$\hat{p} = \frac{\sum_i \sum_t \hat{e}_{it} \hat{e}_{it-1}}{\sum_i \sum_t \hat{e}_{it}^2} \quad (3.9)$$

where \hat{p} is an estimate of the pattern of systematic variation, and all other variables have been previously defined.

Where the independent variable is cash flow from operations, however, equation 3.9 could not be used. In this case, because the systematic variation tends to be absorbed by the lagged values of the independent variable, equation 3.9's estimation of the pattern of systematic variation would be biased (Ostrom, 1978). To obtain a better estimate of the pattern of systematic variation when cash flow from operations is the independent variable, the following equation was used (Ostrom, 1978, p. 55):

$$\hat{p}' = \frac{\sum_i \sum_t \hat{e}_{it} \hat{e}_{it-1} / T - 1}{\sum_i \sum_t \hat{e}_{it}^2 / T} + \frac{k}{T} \quad (3.10)$$

where \hat{p}' is an estimate of the pattern of systematic variation, k is the number of parameters in the original regression model, and all other variables have been previously defined.

After the pattern of systematic variation was estimated, this information was used in the regression model. With this additional information, the regression

model was able to produce a better estimation of the relationship between future cash flow and each of the independent variables. The models used to incorporate the estimated pattern of systematic variation are as follows (Ostrom, 1978, p. 55):

$$\begin{aligned} (\text{CFO}_{it} - \hat{P}\text{CFO}_{it-1}) = \\ a(1 - \hat{P}) + b(\text{WCO}_{it-1} - \hat{P}\text{WCO}_{it-2}) + v_{it} \end{aligned} \quad (3.11)$$

$$\begin{aligned} (\text{CFO}_{it} - \hat{P}\text{CFO}_{it-1}) = \\ a(1 - \hat{P}) + b(\text{QAO}_{it-1} - \hat{P}\text{QAO}_{it-2}) + v_{it} \end{aligned} \quad (3.12)$$

$$\begin{aligned} (\text{CFO}_{it} - \hat{P}'\text{CFO}_{it-1}) = \\ a(1 - \hat{P}') + b(\text{CFO}_{it-1} - \hat{P}'\text{CFO}_{it-2}) + v_{it} \end{aligned} \quad (3.13)$$

where v = error term of the revised model, and where all other variables have been previously defined.

Two procedures were used to estimate the relationships between future cash flow and each of working capital from operations, net quick assets from operations, and cash flow from operations. First, the three groups of firms--(1) all of the firms combined, (2) firms grouped by SIC number, and (3) firms grouped by cluster--were tested to determine if the data were autocorrelated. Then, for each group whose data were not autocorrelated, the regression models 3.5, 3.6, and 3.7 were used to determine the relationships between future cash flow from operations and each of the independent variables. For each group of firms whose data was found to be autocorrelated, the models 3.11, 3.12, and 3.13 were used to determine these relationships.

Nonlinearity

Another necessary condition of regression analysis is that the function be linear. The F-ratio was used to test whether the functional form of each fitted regression equation for each group of firms is linear (Neter and Wasserman, 1974). Since the F-ratios indicated that no problems with nonlinearity existed, no remedial measures were necessary.

Heteroscedasticity

A further assumption of regression analysis is that the variance of the error terms is constant for all observations. If the variance of the error terms is not constant for all observations, then the variance of the parameters estimated by the model will not be at a minimum. If this condition exists, the regression function is heteroscedastic (Neter and Wasserman, 1974).

An examination of the residuals plotted against either the independent variable or the dependent variable reveals whether the constancy of the error variance is suspect (Neter and Wasserman, 1974). Such an examination in this study indicated that a problem with heteroscedasticity does not exist. Therefore, no remedial measures were needed.

Non-normality

The condition of normality is also an assumption of regression analysis. To determine whether the data are normally distributed, the regression residuals were plotted on normal probability paper. This procedure first plots the

normal distribution of the residuals as a straight line then plots the residuals as they actually fall along the normal distribution line. An examination of how closely the residuals follow the normal distribution line reveals whether or not the data are normally distributed (Neter and Wasserman, 1974). This examination indicated that the data used in this study are normally distributed.

Analysis of Relationships

The three fitted regression equations of each group of firms were compared to determine which independent variable --working capital from operations, net quick assets from operations, or cash flow from operations--has the strongest relationship with future cash flow from operations. The strength of the relationship between future cash flow from operations and each of the independent variables is an indication of the effectiveness of each independent variable in predicting future cash flow from operations. The coefficient of determination (r^2) is a measure of the independent variable's ability to explain variation in the dependent variable, indicating the goodness of fit of the relationship (Neter and Wasserman, 1974). Therefore, it was used to measure the strength of the relationship of each regression equation.

The independent variable whose regression equation produced the largest coefficient of determination is considered to be the funds flow measure that is apparently

best able to predict future cash flow from operations. This procedure is consistent with that used in prior research (Greenberg et al., 1986; Fisher, 1980) and is further supported by the fact that the coefficient of determination of each regression equation is a measure of the ability of each of the independent variables to explain the variation in future cash flow from operations.

A test of the differences between the error variances of the three models was used to determine if the difference between the regression function producing the largest r^2 and the other two regression functions was statistically significant. This test provides an indication of the portion of the variability of the dependent variable that the independent variable is unable to explain. The variance of the error term produced by the best fitted regression was statistically compared, by use of an F test, to the error variance produced by the next best fitted regression.

Where the difference between the variances of the two error terms was found to be statistically significant, the independent variable producing the largest r^2 was regarded as most accurate in predicting future cash flow. The F test was also used to determine whether the difference between the error variances of the regression function producing the smallest r^2 and the other two regression functions is statistically significant. A statistical difference indicated that the independent variable producing the smallest r^2 was least able to predict future cash flow.

Expectations of Hypotheses Tests

The first three pairs of hypotheses are designed to determine which of the three funds flow measures--working capital from operations, net quick assets from operations, or cash flow from operations--is most effective in predicting future cash flow from operations.

- H1A: Working capital from operations is no more accurate in predicting future cash flow from operations than net quick assets from operations.
- H1B: Net quick assets from operations is no more accurate in predicting future cash flow from operations than working capital from operations.
- H2A: Working capital from operations is no more accurate in predicting future cash flow from operations than cash flow from operations.
- H2B: Cash flow from operations is no more accurate in predicting future cash flow from operations than working capital from operations.
- H3A: Net quick assets from operations is no more accurate in predicting future cash flow from operations than cash flow from operations.
- H3B: Cash flow from operations is no more accurate in predicting future cash flow from operations than net quick assets from operations.

Prior research has shown that accrual accounting measures are better predictors of future cash flow than cash accounting measures (see end note 1). Results of this investigation are expected to substantiate these earlier findings. Therefore, both hypotheses H1A and H2A are expected to be rejected. Since rejection of H1A and H2A will indicate that working capital from operations is the best predictor, the other hypotheses are expected to be disregarded. Because working capital from operations is based more on

accrual measures, it is expected to be most effective in predicting future cash flow from operations.

Tests of hypotheses H4, H5, and H6 will answer the question of whether industry factors affect the ability of the three funds flow measures to predict future cash flow from operations.

H4: The effectiveness of cash flow from operations in predicting future cash flow does not differ across industries.

H5: The effectiveness of net quick assets from operations in predicting future cash flow does not differ across industries.

H6: The effectiveness of working capital from operations in predicting future cash flow does not differ across industries.

Prior research has found that the relationship of accrual accounting variables to future cash flow differed across industries (Costigan, 1985 and Gombola and Ketz, 1981). Therefore, all three hypotheses, H4, H5, and H6, are expected to be rejected. The rejection of these hypotheses will indicate that industry factors do influence the ability of these three funds flow measures to predict future cash flow. By retaining a larger number of firms, this study will include a more representative sample of firms and industries than were included in both Costigan's and Gombola and Ketz's studies. Therefore, the results of this study are expected to reflect the effect of industry factors on the relationship between each of the funds flow measures and future cash flow more accurately.

Hypotheses H7, H8, and H9 address the a priori expectations of the effect of asset composition on the predictive ability of the three funds flow measures. These three hypotheses are designed to determine whether the levels of accounts receivable, accounts payable, and inventory influence the effectiveness of working capital from operations, net quick assets from operations, and cash flow from operations in predicting future cash flow from operations as a priori expected.

- H7: Cash flow from operations is no more effective in predicting future cash flow for companies that maintain relatively small amounts of receivables, payables, and inventory than either net quick assets from operations or working capital from operations.
- H8: Net quick assets from operations is no more effective in predicting future cash flow for companies that maintain relatively large amounts of receivables and payables but low levels of inventory than either cash flow from operations or working capital from operations.
- H9: Working capital from operations is no more effective in predicting future cash flow for companies that maintain relatively large amounts of inventory than either cash flow from operations or net quick assets from operations.

A priori expectations, developed earlier, are that cash flow from operations will be the best predictor of future cash flow from operations in industries with relatively small amounts of receivables, payables, and inventory; that net quick assets from operations will be the best predictor in industries with relatively large amounts of receivables and payables but small amounts of inventory; and that working capital from operations will be best in industries

with large amounts of inventory. Based on these a priori expectations, all three hypotheses, H7, H8, and H9, are expected to be rejected. Since no prior research testing these relationships was discovered, expectations of rejecting these hypotheses are based on the a priori expected relationships alone and not on results of prior research. Failure to reject these hypotheses will indicate that the a priori expected relationships cannot be supported.

End Notes

¹Of particular interest to this research, Costigan's (1985) study found that the ability of his accrual variables to predict future cash flow were affected by industry type, and Gombola and Ketz's (1981) study found that the relationship between the variables that they used and future cash flow differed across industries. For other research establishing the existence of and the importance of industry effects see King, 1966, Nerlove, 1988; Fabozzi and Francis, 1979; Brown and Ball, 1967; Magee, 1974; Albrecht, Lookabill, and McKeown, 1977; Watts and Leftwich, 1977; Foster, 1978; Lev, 1974.

²Using firms with complete data, Bowen et al. (1986) compared reported working capital from operations to approximated working capital from operations. They found the difference between the two measures to exceed 5% of reported working capital from operations for 16.9% of the firms and to exceed 10% for 6.7% of the firms. Therefore, the time period used in this study begins after 1971 so that approximations were not needed for most data.

³For example, Costigan (1985), using a twenty-year period, ended up testing only four industries with the largest number of firms in one industry being twenty-four. The other three industries he tested contained between twelve and fifteen firms each.

⁴See Largay and Stickney, 1980; Bowen et al., 1986; Greenberg et al., 1986; Casey and Bartczak, 1984 and 1985; Fisher, 1980; Thode et al., 1986; Gombola and Ketz, September-October, 1983.

CHAPTER FOUR

DATA ANALYSIS

Statistical Analysis

In this chapter are presented the statistical tests used to determine the results of the three research questions posed in this study. These results are analyzed and reported and are then compared to expected results. For the first two questions, the expected results are based on the findings of prior research in this area. Expected results of the investigation of the third question, however, are based on the a priori expected results developed in the first chapter of this study.

Tests of the First Three Pairs of Hypotheses (Overall Predictive Ability)

The first three pairs of hypotheses tested were:

- H1A: Working capital from operations is no more accurate in predicting future cash flow from operations than net quick assets from operations.
- H1B: Net quick assets from operations is no more accurate in predicting future cash flow from operations than working capital from operations.

- H2A: Working capital from operations is no more accurate in predicting future cash flow from operations than cash flow from operations.
- H2B: Cash flow from operations is no more accurate in predicting future cash flow from operations than working capital from operations.
- H3A: Net quick assets from operations is no more accurate in predicting future cash flow from operations than cash flow from operations.
- H3B: Cash flow from operations is no more accurate in predicting future cash flow from operations than net quick assets from operations.

The purpose of testing these hypotheses was to determine which operating funds flow measure--working capital, net quick assets, or cash--is the most effective overall predictor of future cash flow from operations. To test the first three pairs of hypotheses, the funds flow measure whose regression function produced the largest r^2 for a model including all of the firms was found. That funds flow measure was then compared, by using an F test, to the other two measures to determine if the difference was statistically significant. A statistically significant difference will indicate that the operating funds flow measure producing the largest r^2 is the best overall predictor of future cash flow.

Since potentially six tests must be made for each group of firms, an alpha level of .01, rather than a larger level of .05 or .10, was used. This precaution was necessary because each additional hypothesis test increases the probability that a type one error (rejection of the hypothesis when, in fact, it is true) will occur. The true

alpha level resulting from multiple hypotheses tests can be computed as

$$a' = 1 - (1 - a)^m \quad (4.1)$$

where: a' = true alpha level

a = selected alpha level

m = number of tests conducted.

The true alpha level resulting from six hypotheses tests, where the selected alpha level is .01, is equal to .068. Since the first two primary hypotheses are expected to be rejected, however, the remaining four hypotheses are not expected to be tested. Therefore, by testing only two hypotheses instead of six, the significance of the F test is expected to be at an alpha level of .02 rather than .068.

Before these hypotheses were tested by using all of the originally sampled firms, they were tested by using all 100 firms that used the first in, first out (FIFO) inventory valuation method and then by using all 32 firms that used the last in, first out (LIFO) inventory valuation method. The results of separately testing these two groups of firms were compared to determine if significant differences between them could be found. These separate tests of the FIFO and the LIFO firms were conducted because the possibility exists that differences in the accounting methods used for inventory valuation may affect the relationship between future cash flow and each of the operating funds flow measures. Differences in inventory valuation method were analyzed in this study because of the

a priori expectation that inventory size has a significant effect on a firm's ability to generate cash flows in the following year. Differences in other accounting methods are not as apparently important to this study and, therefore, were not analyzed.

Gonedes and Dopuch in "Economic Analyses and Accounting Techniques: Perspective and Proposals" (1979) suggest that restating accounting numbers so that they are all based on the same accounting method may not take into account the fact that management's decisions could have been affected by the accounting method that was used. Thus, accounting income numbers are probably affected not only by the accounting method used but also by management's reaction to that accounting method. A better procedure of investigating any effects of differences in accounting methods used may be to replicate the study for firms grouped by accounting method used. Therefore, the analyses used in this study were replicated both for FIFO firms and for LIFO firms. Differences in the results of testing each of these groups of firms were then analyzed.

The results of separately testing FIFO and LIFO firms indicate that the inventory valuation method used does affect the relationship between future cash flow and each of the operating funds flow measures. Working capital from operations was found to be the best predictor of future cash flow for the FIFO firms while none of the operating funds flow measures could be considered best for the LIFO firms.

Therefore, this study excluded firms using LIFO from all further analyses because of the inability to compare inventory values as enumerated in Chapter 3.

After excluding the LIFO firms, all of the remaining firms (454) in the sample were used to test the first three pairs of hypotheses. The results of these tests are presented in Table 4.1. As expected, hypotheses H1A and H2A were rejected; therefore, H1B and H2B were not tested. The

Table 4.1

Examination of the First
Three Pairs of Hypotheses

<u>Hypothesis</u>	<u>Result</u>	<u>Error variances</u>	<u>F value</u>	<u>Prob. F</u>
H1A	Rejected	QAO 10685 WCO 9391	1.14	<.001
H1B	Not tested			
H2A	Rejected	CFO 12232 WCO 9391	1.30	<.001
H2B	Not tested			
H3A	Rejected	CFO 12232 QAO 10685	1.14	<.001
H3B	Not tested			

WCO = Working capital from operations
QAO = Net quick assets from operations
CFO = Cash flow from operations

rejection of both H1A and H2A indicates that working capital from operations is the best predictor of future cash flow.

Hypothesis H3A was then tested to determine if net quick assets from operations is a better predictor of future cash flow than cash flow from operations. As expected, hypothesis H3A was rejected (see Table 4.1), indicating that net quick assets from operations is better than cash flow from operations in predicting future cash flow. Since hypothesis H3A was rejected, H3B was not tested.

These results indicate that, as expected, working capital from operations is the most effective predictor of future cash flow from operations. Moreover, net quick assets from operations, which also contains accrual measures, is the second most effective predictor of future cash flow, with cash flow from operations being least able to predict future cash flow. These results, reported in Table 4.2, support the contentions of earlier research that accrual

Table 4.2

Overall Predictive Ability of the Three
Operating Funds Flow Measures

Independent variable	r^2	Rank
WCO	.6504	1
QAO	.6022	2
CFO	.5270	3

measures contain information useful in predicting future cash flow. Based on these results and the results of prior research, working capital from operations is considered the most effective of these three operating funds flow measures in predicting future cash flow for companies in general.

These results are reported in Table 4.2 which reveals the value of r^2 as computed by each regression function. The ability of each operating funds flow measure is ranked, based on the value of the computed r^2 . The difference in the ranks for all three measures was statistically significant at an alpha level less than .01.

Tests of Hypotheses 4, 5, and 6 (Predictive Ability With Respect to Industry)

The second group of hypotheses tested were:

- H4: The effectiveness of cash flow from operations in predicting future cash flow does not differ across industries.
- H5: The effectiveness of net quick assets from operations in predicting future cash flow does not differ across industries.
- H6: The effectiveness of working capital from operations in predicting future cash flow does not differ across industries.

The purpose of testing these hypotheses was to determine whether type of industry affects the ability of the three operating funds flow measures of working capital, net quick assets, and cash to predict future cash flow from operations. In testing hypotheses H4, H5, and H6, the firms were first grouped by industry based on their two-digit SIC code. Then, the three regression equations were fitted

separately for each industry. These fitted regression functions were also statistically tested as described in the previous chapter. Results of the tests indicated which measure is most effective in predicting future cash flow, which measure is next-best, and which measure is least effective for each industry.

Table 4.3

Description of Industries Analyzed

<u>SIC</u> <u>Number</u>	<u>Industry Description</u>
13	Oil and gas
23	Apparel manufacturers
24	Forest products
28	Chemicals
33	Metals
34	Hardware and tools
35	Machinery and Equipment
36	Electronics
37	Automotive and aerospace
38	Research and photographic equipment
45	Truckers and air transportation
50	Durable goods
65	Real estate
67	Investments
73	Business services

The rankings of each funds flow measure's predictive ability were then examined to determine whether each funds flow measure had the same rank for each industry or if the ranks differed across industries. Rejection of all three hypotheses would indicate that the ability of each funds flow measure to predict future cash flow does differ across industries, as expected. Conversely, failure to reject would mean that there was no evidence that industry effects affected the predictive ability of the three funds flow measures.

These hypotheses were tested for each of fifteen industries containing between ten and seventy firms. Although more than fifteen industries were included in the sample, industries represented by fewer than ten firms were not used in this analysis. A description of these fifteen industries and the two-digit SIC number of each is presented in Table 4.3.

The results of testing hypotheses 4, 5, and 6 indicate that, as expected, the ability of each operating funds flow measure to predict future cash flow does differ across industries. In Table 4.4 industries are listed by SIC numbers, and the number of firms in each industry is shown. Table 4.4 also shows the value of the r^2 produced by each independent variable for each industry and ranks the predictive ability, based on the values of the r^2 s, of each independent variable for each industry.

Table 4.4

Predictive Ability of the Three
Operating Funds Flow Measures
With Respect to Industry

SIC Industry Number	Number of Firms	WCO		QAO		CFO	
		r ²	Rank	r ²	Rank	r ²	Rank
13	19	.7024	2	.6378	3	.7786	1
23	13	.0227	2	.0039	3	.0612	1***
24	10	.9471	3***	.9673	1**	.9536	2**
28	16	.9321	1***	.8809	2	.8704	3
33	11	.4162	2	.4668	1	.3799	3
34	12	.5234	1*	.4117	2*	.3246	3*
35	21	.1519	2***	.1390	3***	.1974	1***
36	70	.8341	1***	.7618	3***	.7655	2***
37	20	.6533	1***	.4104	3*	.5101	2*
38	10	.6147	1*	.4886	2*	.3584	3***
45	14	.6861	1	.6210	3	.6482	2
50	10	.3640	1	.2245	2	.0416	3
65	21	.0393	3	.0605	2	.0730	1
67	30	.5272	1***	.3275	3***	.4604	2***
73	12	.9230	1	.9185	2	.8865	3**

* alpha < .10

** alpha < .05

*** alpha < .01

As can be seen in Table 4.4, the ability of working capital from operations to predict future cash flow, as

compared to the abilities of both net quick assets from operations and cash flow from operations, does differ across industries. Working capital from operations is best able to predict future cash flow in nine industries, second-best in four industries, and worst in two industries. Not only do these rankings differ across industries, but they also differ significantly, as determined by the F test, in eight of the industries. At the significance level of alpha less than .01, working capital was found to be the best predictor in four industries, second-best in one industry, and worst in one industry. It was also found to be significantly best at an alpha level of less than .10 in two industries.

Differences in the ability to predict future cash flow across industries were also found when net quick assets from operations was compared to the other two funds flow measures. As reported in Table 4.4, net quick assets from operations is the most effective predictor in two industries, the next-most effective in six industries, and the least effective in seven industries. These differences were found to be significant, as determined by the F test, in seven of the industries. In one industry, at an alpha level of less than .05, net quick assets from operations was found to be the best predictor of future cash flow. At a significance level of alpha less than .10, net quick assets was found to be the second-best predictor of future cash flow in two industries. In two other industries at an alpha level less than .01 and in one industry at an alpha of less

than .10, net quick assets was found to be least able of the three operating funds flow measures to predict future cash flow.

The ability of cash flow from operations to predict future cash flow, as compared to the other two funds flow measures, also varies across industries (see Table 4.4). It is the best predictor in four industries, second-best in five industries, and worst in six industries. In determining the significance of these differences, cash flow from operations was found to be the best predictor of future cash flow at an alpha of less than .01 in two industries. It was found to be second-best at a significance level of alpha less than .01 in two industries, at an alpha level of less than .05 in one industry, and at an alpha level of less than .10 in one industry. It was found to be the worst predictor at alpha less than .01 in one industry, at alpha less than .05 in one industry, and at alpha less than .10 in one industry. These results indicate that the ability of each of the three operating funds flow measures to predict future cash flow as compared to one another does differ across industries.

Not only do these measures differ in predictive ability as compared to one another, but, as shown in Table 4.4, each measure also differs in comparison to its own ability to predict future cash flow across industries. The predictive ability of working capital from operations, as measured by the r^2 , is more than .9 in three industries, but it is less

than .2 in three other industries. Also, considerable differences in the magnitudes of the r^2 s were found in the remaining nine industries.

Similar results were observed in the predictive ability of net quick assets from operations across industries. In two industries the r^2 was greater than .9 while in three other industries, the r^2 was less than .2. The r^2 s produced by net quick assets from operations in the remaining ten industries are also quite varied in magnitude.

Extreme differences were also found in the ability of cash flow from operations to predict future cash flow across industries. The r^2 produced by cash flow from operations was greater than .9 in one industry but smaller than .2 in four industries. Among the remaining ten industries the magnitudes of the r^2 s were also quite different.

In summary, the existence of variations in predictive abilities of the three operating funds flow measures across industries were analyzed two different ways. First, the predictive abilities of the three measures for each industry were compared and then ranked. An examination of the rankings across industries indicated that the ability of each measure, as compared to the abilities of the other two measures, does differ across industries, and in many cases, this difference is statistically significant. Secondly, the r^2 s produced by each measure for each industry were analyzed. Extreme differences in the magnitudes of the r^2 s

were found across industries for each of the three operating funds flow measures. The results of both of these analyses support the findings of prior research of the existence of and importance of industry effects .

Tests of Hypotheses 7, 8, and 9 (Actual Predictive Ability Compared to Industry and Cluster Expected Predictive Ability)

The third group of hypotheses tested were:

- H7: Cash flow from operations is no more effective in predicting future cash flow for companies that maintain relatively small amounts of receivables, payables, and inventory than either net quick assets from operations or working capital from operations.
- H8: Net quick assets from operations is no more effective in predicting future cash flow for companies that maintain relatively large amounts of receivables and payables but low levels of inventory than either cash flow from operations or working capital from operations.
- H9: Working capital from operations is no more effective in predicting future cash flow for companies that maintain relatively large amounts of inventory than either cash flow from operations or net quick assets from operations.

Hypotheses H7, H8, and H9 were tested to determine whether the predictive ability of each operating funds flow measure is as expected, based on a priori anticipated results developed in the first chapter. These hypotheses were tested both for industries and for clusters of firms. The industry analysis was based on the two-digit SIC code using the same fifteen industries as used in the industry analysis of hypotheses H4, H5, and H6.

For the cluster analysis, the firms were clustered into four groups by using the SAS FASTCLUS procedure. This method

is effective for large amounts of data (in excess of 100 observations) when one or more variables are used as the basis for clustering the observations (SAS, 1982). This procedure requires the researcher to specify the number of clusters the data is to be grouped into. The researcher, therefore, must specify several different numbers of cluster groups and examine each to find the optimum number to use. In determining the optimum number of clusters for this study, three criteria were considered:

1. a visual examination of the plotted cluster groups;
2. differences in the relative sizes of the means of accounts receivable, inventory, and accounts payable between the clustered groups; and
3. the r^2 for each variable--accounts receivable, inventory, and accounts payable.

Based on these three criteria, five separate clusterings of the firms were examined--each of three through seven clustered groups. A visual examination of the plot of clusters using three groups revealed three distinctive groups with very little overlap between the groups. However, differences in the relative sizes of the variable means between clusters improved substantially when four clustered groups were used. Additionally, the r^2 of the variables increased with the use of four groups while the plotted clusters remained distinct with only a small amount of overlap between clusters.

Yet, when five groups were used, although the variable r^2 s improved, the visual inspection of the clustered groups revealed a decided overlap between two of the groups.

Further, differences in the relative sizes of the variable means between clusters were not improved over those of four clustered groups. When more than five groups were used, more overlapping between clusters was found with little improvement in the variable r^2 s and no improvement in the relative sizes of the variable means between clusters. Therefore, the analysis of four clustered groups of firms was used for this study.

The a priori expected results for each industry and for each clustered group of firms were determined by the relative sizes of accounts receivable, inventory, and accounts payable as discussed earlier. The same statistical tests described in the previous chapter were used to specify which funds flow measure is actually considered most effective in predicting future cash flow for each industry and for each clustered group of firms. The actual results were then compared to the expected results to determine whether the a priori expectations could be supported.

Cash flow from operations was anticipated to be most effective in predicting the future cash flow of industries and clustered groups of firms characterized by relatively small amounts of receivables, payables, and inventory. If these results are found, then hypothesis H7 can be rejected. On the other hand, if one of the other funds flow measures is the most effective predictor for an industry or cluster with small amounts of receivables, payables, and inventory, H7 cannot be rejected, and the a priori expectations of that

industry or cluster will not be supported. This analysis was conducted for each industry and the clustered group of firms characterized by relatively small amounts of receivables, payables, and inventory.

Each industry and the clustered group of firms characterized by relatively large amounts of receivables and payables but small amounts of inventory were examined in the same manner. If net quick assets from operations is found to be the best predictor, then H8 can be rejected. Conversely, if one of the other measures is best, H8 cannot be rejected, indicating that the a priori expectations are not supported.

An identical examination was conducted for each industry and the clustered group characterized by relatively large amounts of inventory. H9 can be rejected if working capital from operations is the best predictor. If another funds flow measure is the best predictor of future cash flow, however, H9 will not be rejected, and the a priori expectations will not be substantiated.

In the analysis of industries, the operating funds flow measure that is anticipated to be the best predictor of future cash flow for each of the fifteen industries was determined, based on the relative sizes of receivables, inventory, and payables. Then, each anticipated best predictor was compared to the actual best predictor of future cash flow to determine whether the results were as

expected. For eleven of the fifteen industries, the results were not as expected (see Table 4.5).

Table 4.5

Analysis of Industry Results
Versus A Priori Expectations

<u>Industry Results</u>	<u>Expected Best Predictor</u>			<u>Total Industries</u>
	<u>WCO</u>	<u>QAO</u>	<u>CFO</u>	
As expected	4	0	0	4
Not as expected	<u>5</u>	<u>4</u>	<u>2</u>	<u>11</u>
Total industries	<u>9</u>	<u>4</u>	<u>2</u>	<u>15</u>

As can be seen in Table 4.5, the results are as expected for only four of the nine industries for which working capital from operations was anticipated to be the best predictor of future cash flow from operations. The results are not as expected for any of the four industries for which net quick assets from operations was anticipated to be the best predictor. Further, cash flow from operations was not found to be the best predictor of future cash flow for either of the two industries for which it was expected to be best.

While results of this analysis, based on industries, failed to reject any of hypotheses H7, H8, or H9, the analysis of the clustered groups of firms produced mixed results. The results of the clustered group of firms characterized by relatively small amounts of accounts

receivable (.042), inventory (.025), and accounts payable (.199) are as expected. The expectation for this group was that cash flow from operations would be the most effective predictor of future cash flow. As illustrated in Table 4.6, the r^2 produced by the independent variable, cash flow from operations, is significantly larger than that produced by either working capital from operations or net quick assets from operations for this group of firms.

On the other hand, the results of the clustered group of firms characterized by relatively large amounts of inventory (.716) are not as anticipated. Working capital from operations was expected to be the most effective predictor of future cash flow for this group of firms. The results, shown in Table 4.6, indicate, however, that working capital from operations is actually the least effective predictor for this group of firms.

The clustered group of firms characterized by relatively large amounts of accounts receivable (.611) and small amounts of inventory (.124) was expected to have net quick assets from operations as the best predictor of future cash flow. Yet, as indicated in Table 4.6, working capital from operations was found to be most effective in predicting future cash flow for this group of firms.

The analysis of the fourth clustered group of firms produced results as expected. Although the level of inventory (.416) is only moderately large in this cluster, inventory is expected to have some influence on the

generation of future cash flow. Therefore, working capital from operations would be expected to be the best predictor of future cash flow for this cluster. Results of the analysis indicate that working capital from operations is the best predictor of future cash flow, as expected (See Table 4.6).

Table 4.6
Analysis of Firm Clusters

Relative* Size of Cluster Accounts			Number of Firms	WCO		QAO		CFO	
Ac/Rec	Inv Ac/Pay	Ac/Pay		r ²	Rank	r ²	Rank	r ²	Rank
.042	.025	.199	39	.7213	2	.7154	3	.8046	1
.105	.716	.264	58	.2935	3	.4775	1	.4555	2
.611	.124	.280	276	.7422	1	.6974	2	.6082	3
.342	.416	.155	72	.8110	1	.7484	2	.7411	3

All rankings are significant at alpha < .01

*to total current assets

Summary and Interpretation Of the Results

Results of Tests of the First Three Pairs of Hypotheses

Tests of the first three pairs of hypotheses, using all firms, indicate that working capital from operations is more effective in predicting future cash flow than both cash flow from operations and net quick assets from operations. This finding supports those of the four earlier studies which

compared the predictive effectiveness of cash and accrual measures of operations (Costigan, 1985; Bowen et al., 1986; Greenberg et al., 1986). Those studies concluded that accrual measures of operating results are usually better predictors of future cash flow than cash measures, and this study concurs with those conclusions.

These results provide strong support for results of earlier studies because of three major improvements in the methodology of this study over earlier studies. First, this study includes 454 firms which is substantially more than the number analyzed in prior research. Greenberg et al. (1986) analyzed a total of 157 firms; however, several of these firms were eliminated because of problems with autocorrelated data. Bowen et al. (1985) included 324 firms in their study. Costigan (1985) used 85 firms; and Fisher (1980) analyzed 50 firms.

Second, this study employed a cross-sectional, time series regression model to measure the strength of the relationship between each of the three operating funds flow measures and future cash flow. This approach is better able to detect the overall effectiveness of each operating funds flow measure than the methods used in prior research because the inclusion of large numbers of firms in the regression analysis provided more data from which to estimate the relationships. This approach also facilitates the use of statistical tests, rather than an ad hoc approach, to determine whether differences in predictive ability between

the operating funds flow measures are significant. Moreover, because of the large amount of data, results of the statistical tests are more reliable.

Both Greenberg et al. (1986) and Fisher (1980) applied separate regression models to each firm for each independent variable. They then compared the r^2 produced by each model to determine which was largest for each firm. Neither researcher tested the differences in the individual r^2 s for statistical significance. They simply reported the number of firms for which the resulting r^2 was largest for each independent variable. The independent variable producing the largest r^2 for the greatest number of firms was deemed to be best able to predict future cash flow.

Bowen et al. (1986) used a separate simple linear model for each predictor variable for each year. The median absolute forecast error produced by each model was ranked each year. The ranks were then averaged across years, and this average was used to determine which variable was the best predictor of future cash flow. Although a nonparametric test was used, only the averaged rank of each predictor variable was tested. Further, the null hypothesis was rejected if only one other predictor variable was better or worse than the variable tested. Thus, while one variable may be different, all of the other variables could possibly be equal in predictive ability to the variable tested.

Costigan (1985) also used a cross-sectional, time series model. However, he did not directly compare the

effectiveness with which cash flow from operations predicts future cash flow to the predictive effectiveness of the other operating funds flow measures. Instead, he used the predictive ability of cash flow from operations as the basis from which to evaluate the ability of the other measures to incrementally improve the prediction of future cash flow. While he did find that cash flow from operations contains information useful to the prediction of future cash flow, he did not determine which operating funds flow measure was the best overall predictor of future cash flow.

A third methodological improvement of this study was to evaluate the predictive effectiveness of each operating funds flow measure after correcting for problems with autocorrelated data. None of the prior studies examined attempted to use information after correcting for this problem. In the two research studies by Costigan (1985) and Bowen et al. (1986), the problem of autocorrelated data was not considered. In the Greenberg et al. (1986) study, firms having autocorrelated data were simply eliminated from the analysis. Although Fisher (1980) tested for and found autocorrelated data, he did nothing to correct the problem.

Since the methodology used in this study is an improvement over that used in prior research, these results provide strong evidence in support of the conclusions of earlier studies. However, because this is apparently a first attempt to use a cross-sectional, time series regression model and to correct for and use autocorrelated

data in this type of research, further studies using this methodology are needed.

Results of Tests of Hypotheses 4, 5, and 6

Tests of H4, H5, and H6 indicate that, as expected, the effectiveness with which each operating funds flow measure predicts future cash flow does differ across industries. The results of this study, then, with its improved methodology lends strong support to the findings of prior research (Gombola and Ketz, 1981; Costigan, 1985). The exact reasons why differences in predictive effectiveness exist, however, remain obscure.

Results of Tests of Hypotheses 7, 8, and 9

The testing of H7, H8, and H9 was an attempt to discover why the predictive effectiveness of the operating funds flow measures does differ across industries. The purpose of these tests was to determine whether the relative sizes of certain current accounts affect the ability of the operating funds flow measures to predict future cash flow. These tests were conducted both on industries, based on the two-digit SIC number, and on clustered groups of individual firms.

Differences in the results of these tests between the two groups analyzed, however, lead to inconclusive findings. Of the nine industries for which working capital from operations was expected to be the best predictor of future cash flow, in only four was working capital from operations found to be best. Yet, in the two clustered groups for

which working capital was expected to be best, working capital was found to be best in one group, while in the other, working capital was found to be the least effective predictor of future cash flow.

Additionally, in four industries net quick assets from operations was expected to be the most effective predictor of future cash flow. Yet, in none of these industries was net quick assets actually found to be the most effective predictor. Further, results of tests of the clustered groups of firms for which net quick assets was expected to be best indicate that net quick assets cannot be considered the best predictor for that group of firms.

The results were similarly ambiguous for the industries and the clustered group of firms for which cash flow from operations was expected to be the most effective predictor of future cash flow. In neither of the two industries for which cash flow was expected to be best was cash flow found to be best. However, cash flow from operations was found to be the most effective predictor of future cash flow in the clustered group of firms for which it was expected to be best.

These inconclusive results indicate the existence of one of three possible situations:

1. The relative sizes of the current accounts (accounts receivable, inventory, and accounts payable) do not affect the ability of the operating funds flow measures to predict future cash flow, and any apparent influence of these current accounts is merely coincidence.

2. The relative sizes of these current accounts do affect the ability of the operating funds flow measures to predict future cash flow as expected, but the influence of other, undefined, factors has a greater effect on the ability of the operating funds flow measures to predict future cash flow in some cases than these current accounts.
3. In some cases, the relative sizes of these current accounts do affect the ability of the operating funds flow measures to predict future cash flow, while in other cases, their effect is negligible.

Further research is needed to determine which of these situations exists.

CHAPTER FIVE

RESULTS AND CONCLUSIONS

This concluding chapter presents a summary of the research findings of this study and their implications. The limitations of this research are also identified and discussed. Finally, suggestions for future research needed in this area are detailed in this chapter.

Summary

In November of 1987, the FASB issued Statement of Financial Accounting Standards No. 95, "A Statement of Cash Flows," which requires that all firms report funds flow information by using cash as the measurement basis. In previous pronouncements, the FASB advocated the reporting of information that is useful for predicting future cash flows. One purpose of this study was to determine whether the cash basis is actually better than either of two previously allowed reporting bases--working capital from operations or net quick assets from operations--for predicting future cash flow.

Prior research has found that industry characteristics affect the ability of accrual accounting measures to predict future cash flow (Costigan, 1985). Additionally, other research studies have found that differences in industry classification were useful in explaining variations in other variables. Therefore, the second purpose of this research was to determine if the reporting concept best for predicting future cash flow was dependent upon industry classification.

Finally, differences in the components of each of working capital from operations, net quick assets from operations and cash flow from operations were analyzed. Cash flow from operations contains no accrual-based accounts. Net quick assets from operations contains accounts receivable and accounts payable which are accrual accounting measures. In addition to accounts receivable and accounts payable, inventories are contained in working capital from operations. The third purpose of this study, therefore, was to determine whether differences in the relative sizes of these accrual-based accounts affected the ability of each of the three operating funds flow measures to predict future cash flow.

To test the overall effectiveness with which each operating funds flow measure predicts future cash flow, a cross-sectional, time series regression model was used for 454 firms over a ten-year period. Prior research found that accrual measures of operating funds flow generally predict

future cash flow better than cash measures (Greenberg et al., 1986; Bowen et al., 1986; Fisher, 1980). While significant differences exist between the research methodologies used in the earlier studies and the research methodology used in this study, the overall results of this study support the findings of that earlier research.

A cross-sectional, time series regression model was also used to determine whether one operating funds flow measure is best for predicting future cash flow for all industries or if different measures are better predictors for some industries. For this part of the study, the fifteen industries (based on the two-digit SIC number) with ten or more firms were each tested separately. Since the results indicated that the measure found to be the most effective predictor of future cash flow did differ across industries, the ability of the three operating funds flow measures to predict future cash flow was considered to be dependent upon industry classification.

In the third part of this study, the composition of working capital from operations, net quick assets from operations, and cash flow from operations was found to differ with respect to the inclusion of accounts receivable, accounts payable, and inventory. Therefore, differences in the relative sizes of these accounts were tested to determine whether these differences affected the abilities of each of the three operating funds flow measures to predict future cash flow. For this analysis, differences

among industries and differences among firms grouped by cluster analysis were tested. Each industry and each cluster were categorized (based on the relative sizes of accounts receivable, inventory, and accounts payable) as to which operating funds flow measure was expected to be the best predictor of future cash flow for that industry or that cluster.

This categorization indicated that for nine of the industries, working capital from operations was expected to be the best predictor of future cash flow. Net quick assets was expected to be the best predictor for four industries. For the remaining two industries, cash flow from operations was expected to be the best predictor.

The cluster analysis resulted in grouping the firms into four separate clusters. An analysis of the relative sizes of accounts receivable, accounts payable, and inventory of each of these four clusters indicated that for two of these clusters, working capital from operations was expected to be the best predictor of future cash flow. Net quick assets from operations was expected to be the best predictor for a third cluster, and cash flow from operations was expected to be best for the remaining cluster.

A cross-sectional, time series regression model was applied to each industry and each cluster to determine the actual best predictor of future cash flow for that industry and for that cluster. A comparison of the actual best predictors to the expected best predictors indicates that in

the majority of cases for the industries the results are not as expected. The results were contrary to expectations for all of the six industries for which the expected best predictors were either net quick assets from operations or cash flow from operations. Moreover, the results were as expected for only four of the nine industries for which working capital from operations was expected to be the best predictor. These results indicate that the relative values of accounts receivable, accounts payable, and inventory are not as useful in determining the predictive accuracy of the three operating funds flow measures for different industries as they were expected to be.

The results of comparing the actual best predictors to the expected best predictors for the clusters indicate that the results for two of the clusters are as expected, while the results for the remaining two clusters are contrary to expectations. The results were as expected for the cluster for which cash flow from operations was expected to be the best predictor of future cash flow. However, the results were not as expected for the cluster for which net quick assets from operations was expected to be best. While the results were as expected for one of the two clusters for which working capital was expected to be the best predictor, the results were contrary to expectations for the other cluster for which working capital was expected to be best.

These results indicate that the lack of relatively large amounts of accounts receivable, accounts payable, and

inventory apparently did affect the ability of cash flow from operations to predict future cash flow. However, the presence of relatively large amounts of accounts receivable and accounts payable accompanied by relatively small amounts of inventory did not appear to affect the predictive ability of net quick assets from operations. Because working capital from operations was the best predictor of future cash flow for one of the two clusters for which it was expected to be best, the relative size of inventory apparently had some effect on its ability to predict future cash flow. Therefore, since the presence of relatively small amounts of inventory affected the ability of cash flow from operations to predict future cash flow and the presence of relatively large amounts of inventory had some effect on the predictive ability of working capital from operations, the relative size of inventory is considered more useful in determining which operating funds flow measure is best able to predict future cash flow than the relative sizes of accounts receivable or accounts payable.

Research Implications

The results of testing the overall effectiveness of each of the three operating funds flow measures for predicting future cash flow indicate that while cash flow from operations does contain some information useful in predicting future cash flow, as assumed by the FASB, accrual operating funds flow measures are more effective predictors of future cash flow. Prior research found working capital

from operations to be the most effective overall predictor of future cash flow. This study, with its improved methodology, provides strong support for those findings.

Although the first part of this study supports prior research findings that accrual measures of operations are more useful in predicting future cash flow than cash measures, a question arises due to the results of the second part of the study. The results of the second part of this study indicate that no one operating funds flow measure is consistently the best predictor of future cash flow for all industries. These results are consistent with the findings of earlier research of the existence of and importance of industry effects. Based on the results of this part of the study as well as the results of prior research, the FASB's requirement that all firms use the same basis in reporting funds from operations is questioned. A more flexible financial accounting standard allowing different reporting concepts to be used in presenting operating funds flow information may be more appropriate.

The purpose of the third part of this study was to determine whether the relative sizes of accounts receivable, inventory, and accounts payable affect the ability of each of the operating funds flow measures to predict future cash flow as posited in the first chapter. In this part, two different groups of firms were analyzed--firms within the same industry and cluster-grouped firms. The expected results for both groups were based on the relative sizes of

accounts receivable, inventory and accounts payable. The results of this third part, however, were, on the whole, not as expected.

The results were as expected, when expectations were based on the composition of assets for the average firm in each industry, for only four of the fifteen industries analyzed. For all four of these industries, working capital from operations was expected to be the best predictor of future cash flow. In five other industries for which working capital was expected to be best, however, one of the other funds flow measures was found to be the best predictor of future cash flow instead. Moreover, none of the results were as expected for the industries for which either net quick assets from operations or cash flow from operations was expected to be the best predictor of future cash flow. These unexpected industry results indicate that the relative sizes of accounts receivable, inventory, and accounts payable do not have as much effect on the abilities of the three operating funds flow measures to predict future cash flow as was anticipated.

The results of two of the four clusters were also not as expected. Net quick assets from operations was not found to be the best predictor of future cash flow for the cluster for which it was expected to be best. Apparently, large levels of accounts receivable accompanied by small levels of inventory do not affect the ability of net quick assets from

operations to predict future cash flow for the clustered firms as expected.

Although the results for one of the two clusters for which working capital from operations was expected to be the best predictor of future cash flow were contrary to expectations, the results for the other cluster for which working capital was expected to be best were as expected. These conflicting results indicate that inventory may affect the ability of working capital from operations to predict future cash flow. However, a different grouping of the firms or a different measure of inventory may identify the relationship between working capital from operations and future cash flow better.

The results for the cluster for which cash flow from operations was expected to be the best predictor of future cash flow were also as expected. These results are contrary to the results for the two industries for which cash flow was expected to be best. This further indicates that a better grouping of the firms may be necessary to find a meaningful relationship between firm grouping and the differences in the predictive abilities of the operating funds flow measures.

Although these results are, as a whole, not as expected, they do not negate the possibility that these current accounts are important factors in the determination of which operating funds flow measure is most effective in predicting future cash flow. The measurement of these

accounts may be mis-specified in this study. Some other measurement of these accounts, such as their turnover, may be more useful in determining which operating funds flow measure will best predict future cash flow.

A further implication of this part of the study is that the results of using cluster-grouped firms conformed more to expectations than the results of using industry classifications in determining the best predictor of future cash flow. This result indicates that an improved method of grouping the firms may be better able to identify the cause of differences in the effectiveness of each of the operating funds flow measures in predicting future cash flow. Further, if the measurement of the current accounts can be specified better, one type of classification may be found to be more useful in the determination of which operating funds flow measure is the best predictor of future cash flow.

Limitations

Because of the methodology used in this study, certain limitations are present. As mentioned earlier, the firms included all firms available on Compustat meeting the requirements of this study. Since Compustat does not contain all existing firms and since many firms did not meet the requirements of this study, the resulting sample of firms may be biased. The sample consists of survived, non-merged firms that do not use LIFO as the primary inventory valuation method. Although this limits the generalizability of the results, it does not invalidate them.

Although Compustat is used because of its many advantages, its use also presents a limitation. The Compustat figures are self-reported, as opposed to being audited or examined by an independent party. Therefore, although several validation procedures are used by Compustat (Industrial Compustat, 1985), these numbers are subject to possible undetected error.

The relatively short time period used may also be a limitation of this study. A longer time period might improve the statistical acceptability of the results of the regression analyses. However, the increased number of firms available from the shorter time period and the more reliable data are expected to outweigh the limitations caused by the use of this shorter time period.

The variables used in this study are the simple values of the funds flow measures. A review of the literature revealed studies that also used the simple values of their accounting measures.¹ However, several other studies used measures adjusted in various ways, such as by taking first differences or percentage changes, by using components of the measures, or by averaging the measures.² Yet, the literature review did not indicate a best value that should be used. Therefore, the relationships between simple values of the funds flow measures and future cash flow were determined in this study.

The difficulty of obtaining true measures of cash flow from operations, net quick assets from operations, and

working capital from operations is an additional limitation in this study. Some of the problems encountered in attempting to obtain these measures are listed by Greenberg et al. (1986):

- (1) ambiguity in the definition of "operations,"
- (2) diversity in reporting practices,
- (3) impact of changes in the reporting entity on noncash current accounts,
- (4) use of absorption costing in accounting for manufactured inventory,
- (5) measurement of current portion of long-term leases, and
- (6) reclassifications, rent and noncurrent accounts (p. 270).

Similar to Greenberg et al., this study minimized the effect of criticism (3) by excluding firms that engaged in acquisition or merger activity. Further, since the current portion of long-term debt was excluded in the calculations of the three funds flow measures, criticism (5) was also alleviated. However, due to the lack of data, the remaining problems could not be overcome. Therefore, the funds flow measures used in this study are the best available estimates and must be considered surrogates of the true measures.

The use of linear models may also be a limitation in this study. Since no specific functional form representing the relationship between funds flow measures and future cash flow was found in the literature, the relationship was estimated with linear regression models. However, some other model with a non-linear form could possibly represent these relationships better.

Future Research

The results of the first part of this research have important implications for future research, particularly because of differences in the methodology used in this research as compared to prior research. Prior studies either eliminated firms whose data was autocorrelated or ignored the problem of autocorrelated data. Further, less powerful research designs were used in those earlier studies. Thus, more studies in this area that include corrected autocorrelated data are needed.

The results of the third part of this study also indicate a need for further research in this area. Studies are needed using more detailed analyses of those current accounts--accounts receivable, inventory, and accounts payable--which are theoretically expected to affect the ability of each operating funds flow measure to predict future cash flow. As suggested earlier, measurement of those accounts may have been mis-specified in this study. Other measures of these accounts such as their turnover or their average relative sizes, rather than their year-end relative sizes, could be tested for any effect on the predictive ability of the operating funds flow measures. Additionally, different methods of grouping firms need to be tested to find a method which will allow the relationship between each of the operating funds flow measures and future cash flow to be discovered for different types of firms.

Another approach, such as an incremental approach, may be more useful in determining whether these current accounts significantly affect the ability of each operating funds flow measure to predict future cash flow. Other possible reasons for differences in the predictive effectiveness of the three operating funds flow measures could be identified and included in the model. Then, these current accounts could be added to the model to produce a measure of their incremental effect on the predictive ability of each of the operating funds flow measures.

In conclusion, this research was a first attempt in two important areas. First, corrected autocorrelated data were included in this study. Such data had not been included in other research in this area. Second, the importance of the current accounts--accounts receivable, inventory, and accounts payable--on the predictive ability of the operating funds flow measures had not been tested in prior research. Thus, the suggested additional research is needed to explain or further substantiate the findings of this study.

End Notes

¹Largay and Stickney, 1980; Casey and Bartczak, 1984 and 1985; Greenberg et al., 1986; Bowen et al., 1986; Fisher, 1980; Gombola and Ketz, 1981; Drtina and Largay, 1985; Thode et al., 1986.

²Gentry et al., 1985; Costigan, 1985; Casey and Bartczak, 1984 and 1985; Gombola and Ketz, January 1983 and September-October, 1983; Bowen et al., 1986.

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VITA

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From 1971-1979 she was employed in several different organizations including construction, retailing, banking, and non-business. In 1978 she received her M. B. A. degree from Nicholls State University where she began teaching accounting in 1979.

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DOCTORAL EXAMINATION AND DISSERTATION REPORT

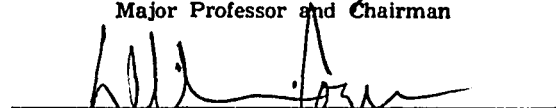
Candidate: Catherine Innes Green Gaharan

Major Field: Accounting

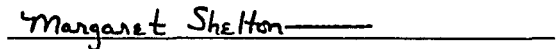
Title of Dissertation: A Comparison of the Effectiveness of the Operating
Funds Flow Measures of Cash, Net Quick Assets, and
Working Capital In Predicting Future Cash Flow

Approved:



Major Professor and Chairman




Dean of the Graduate School

EXAMINING COMMITTEE:









Date of Examination: _____

May 2, 1988