Predicting Cash Flow From Operations: Evidence On The Comparative Abilities For A Continuum Of Measures

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Abstract

Prior studies have attempted to confirm or reject the FASB's assertion in its Conceptual Framework that accrual accounting measures provide better information for predicting cash flows than do cash basis measures. However, their results proved largely inconclusive and contradictory. The current study identifies research constructs that may have driven these inconsistent findings and makes adjustments to mitigate their effects. Univariate cash flow prediction models are developed for companies in the petroleum industry using a continuum of predictor variables. In predicting operating cash flows, one variable, net earnings plus depreciation and amortization, consistently achieves superior results.

Introduction

Cash flow studies represent a major, ongoing line of research. Such studies often examine the usefulness of various cash flow measures in predicting securities prices and business failure. In 1978, the FASB spawned a subset of cash flow research when the Board asserted in Concepts Statement No. 1 that accrual basis accounting information is more useful than cash basis measures in predicting future cash flows. For the last two decades, numerous studies attempted to confirm or reject this contention by examining the comparative predictive abilities of accrual accounting earnings versus cash flow measures. Their results have been largely contradictory and inconclusive.

Even without the FASB's seemingly unsupported assertion, determination of good predictors of future cash flows represents a relevant line of research as one of the three major objec-

tives of financial reporting is that financial statements provide users with information enabling them to assess the timing and extent of entity cash flows. The present study examines prior research in this area and attempts to improve upon their results by developing cash flow prediction models for the petroleum industry using predictors ranging on a continuum from accrual basis earnings to the net cash flow for the period.

Prior Research

Research on the comparative predictive abilities of accrual earnings measures and cash flow measures exists in two primary areas. First, a significant amount of research examined the comparative abilities of accrual earnings and cash flows in predicting securities prices. These studies include those by Wilson (1986), Rayburn (1986), Bowen et al. (1987), Bernard and Stober (1989), Ali (1994), Clubb (1995), Sloan (1996), and Pfeiffer et al. (1998). Second, and most important for the research at hand, are those studies

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that compared accrual earnings measures and cash flow measures as predictors of future cash flows from operations (CFO). These studies are examined in the following paragraphs.

Greenburg et al. (1986) developed univariate regression models to predict CFO using either past net income before extraordinary items or past CFO as the independent variable. They compared the predictive abilities of the models by examining the coefficients of determination (r^2 s) and found that the r^2 s for the accrual earnings models were significantly better than the r^2 s for the cash flow models.

Similar to Greenburg et al. (1986), Bowen et al. (1986) developed several univariate regression models to evaluate the predictive abilities of accrual earnings versus cash flow measures. However, they used a range of predictor variables that captured various levels or stages of accrual earnings and cash flows. Bowen et al. (1986) evaluated the predictor variables by examining the models' residuals or error terms. In predicting CFO, they found that the error terms for the accrual earnings (or net income) models were higher than the error terms for any other predictor variable, although not always significantly higher. These higher error terms suggested that strict accrual earnings was an inferior predictor of CFO, albeit not significantly so when compared to past CFO as a predictor.

Murdoch and Krause (1989) predicted CFO primarily with univariate models and, similar to Bowen et al. (1986), used a range of predictors representing various levels of accrual earnings and cash flows. In addition, they included net sales as a predictor. They evaluated the relative predictive abilities of their models by examining r^2 s and found that past CFO provided no incremental information content over that already provided in their accrual-based prediction models. Murdoch and Krause (1989, p. 112) concluded that "accrual earnings is a better predictor of operating cash flow than operating cash flow itself."

McBeth (1993) examined two variables (i.e., past net income and past CFO) as predictors

of CFO. He developed models with independent variables for one and two years prior to the prediction year. McBeth (1993) seemed to evaluate the comparative predictive abilities of accrual versus cash basis measures mainly by examining the models' r^2 s. He predicted CFO for two years, 1989 and 1990, for the same sample of firms and found that past net income was a better predictor in the 1989 models but that past CFO predicted better in the 1990 models.

Quirin et al. (1999), similar to Bowen et al. (1986) and Murdoch and Krause (1989), predicted CFO using univariate models with predictors ranging on a continuum from accrual earnings to CFO. Quirin et al. (1999) evaluated their models' predictive abilities by examining r^2 s and by using Vuong's (1989) test for non-nested model selection. They found that the best predictor of CFO was past CFO. The traditional accrual earnings (i.e., net income) model resulted in a lower predictive ability than any other independent variable tested.

In summary, Greenburg et al. (1986) and Murdoch and Krause (1989) concluded that accrual earnings measures are better predictors of CFO than are cash basis measures. Yet, Bowen et al. (1986), to a certain degree, and Quirin et al. (1999) found that cash flow measures outperformed accrual earnings in predicting CFO. McBeth's (1993) study produced a similar contradiction within its own results as accrual earnings predicted better in one year while CFO predicted better in another year. Thus, prior studies, with their contradictory findings, have failed to demonstrate that either accrual basis measures or cash basis measures are consistently better predictors of future cash flows. The current study attempts to identify the research constructs that may have driven the inconsistent findings in the prior research and makes adjustments to mitigate their effects.

Deviations from Prior Research

In evaluating the comparative abilities of accrual earnings versus cash flows in predicting future cash flows, the current study differs from prior research in three important ways. First, the

models in the current study were developed with data from one industry only (i.e., the petroleum industry) rather than data from multiple industries, which is how the models were developed in the five aforementioned studies (i.e., Greenburg et al., 1986; Bowen et al., 1986; Murdoch and Krause, 1989; McBeth, 1993; and Quirin et al., 1999). Ward (1994) notes that examining data across industries may have contributed to the poor statistical significance of prior cash flow studies. The usefulness of cash flows or accrual earnings as predictors may be industry specific. Past cash flows might be more important in one industry, while past accrual earnings might be more important in another industry. By concentrating on one industry, the current study eliminates this cross-industry weakening effect that may have plagued prior research.

Second, unlike Greenburg et al. (1986), Murdoch and Krause (1989), and McBeth (1993), who evaluated primarily r^2 s to determine the relative predictive abilities of their models, the current study examines both r^2 s and prediction errors. Problems with using goodness of fit (i.e., r^2) as a measure of predictive ability are well documented. For example, Lorek and Willinger (1996) and Cheung and Krishnan (1997) note that higher r^2 s do not necessarily translate into superior predictive ability. Neter and Wasserman (1974, p. 229) state that a model with a high r^2 may not be useful for predictions because the mean square error may be "too large for inferences to be useful in a case where high precision is required." Akresh and Wallace (1982) suggest that a model's predictive ability be evaluated by performing an analysis of residuals in addition to examining r^2 s, which the current study does.

Third, McBeth (1993) and Quirin et al. (1999) developed their models with pooled cross-sectional intertemporal data using a relatively short annual data base with a large number of companies. More specifically, McBeth (1993) used annual data for three years for 4,415 companies, while Quirin et al. (1999) developed their models using annual data for eight years for 1,442 firms.

The problem created by using short time

periods for each company in a pooled sample with a large number of companies is that results may be driven more by company size than by real economic factors. For example, McBeth's (1993) models achieved r^2 s ranging from .59 to .90. McBeth stated that these unusually high r^2 s likely resulted from him correctly capturing the true measure of cash flows (i.e., he posited that prior studies produced lower r^2 s because they predicted surrogate measures of CFO rather than true CFO). It is just as likely, however, that McBeth's (1993) high r^2 s resulted from his sample selection (i.e., his models were developed from a sample containing data for three years on 4,415 companies of widely varying sizes). The particular independent variable tested (either past net earnings or past CFO) probably acted as a surrogate measure of the size of the company, which is highly related to the dollar amount of future CFO. Similarly, the majority of Quirin et al.'s (1999) models produced r^2 s above .90, which likely occurred because the various independent variables examined were to a large extent simply measuring company size.

The current study also uses a cross-sectional intertemporal data base but overcomes the potential problems suffered by McBeth (1993) and Quirin et al. (1999) by using data on a smaller number of companies within one industry over a longer time period. The sample includes data for 30 companies in the petroleum industry for 40 quarters. With fewer companies and a longer time period for each company, the models in the present study likely were less influenced by company size and more influenced by economic factors related to changes in CFO than were models in the McBeth (1993) and Quirin et al. (1999) studies.

Methodology

The purpose of this study is to evaluate the efficacy of accrual basis measures versus cash basis measures in predicting future cash flows. Unlike Greenburg et al. (1986) and McBeth (1993), who used two dichotomous predictor variables, past net income and past CFO, the present study examines a continuum of independent variables ranging from income before extraordi-

nary items to the net change in cash during the period. Bowen et al. (1986), Murdoch and Krause (1989), and Quirin et al. (1999) tested a similar range of independent variables because they recognized that hybrid variables containing components of both accrual earnings and cash flow measures may prove useful in predicting future cash flows. Also, Arnold et al. (1991), in a study predicting cash flows in the U.K., noted that the full range of entity flows should be examined in predicting cash flows. The current study examines the following independent variables as predictors of future CFO:

- **NI** = income before extraordinary items and discontinued operations.
- **NIDPR** = NI plus depreciation and amortization charges on noncurrent operating assets. This represents an easily-computed surrogate measure of cash flows that still maintains a strong base in accrual earnings.
- **WCFO** = NIDPR plus/minus adjustments to earnings to remove the effects of gains/losses on asset sales and other transactions impacting earnings but producing no cash flow effects (e.g., amortization of bond discounts or premiums).
- **CFO** = WCFO plus/minus changes in the current operating accounts (e.g., receivables, inventory, accounts payable, taxes payable, etc.). In essence, this represents cash flow from operations as currently found in a statement of cash flows prepared in accordance with SFAS No. 95.
- **NCF** = net change in cash and cash equivalents during the year.

Notice that the first variable represents a true accrual earnings measure; each subsequent variable moves closer to the net change in cash, or true net cash flow for the period.

Five univariate regression models were developed; each model predicted CFO one period ahead using one of the above independent variables. CFO represents the measure of interest for cash flow prediction because it is the net cash flow resulting from a company's central operations and is the predominant cash flow figure

predicted in prior research.

The five models were developed with 10 years of quarterly data (i.e., 40 quarters) pooled for 30 companies in the petroleum industry. The data were obtained from COMPUSTAT files. To reduce the effects of seasonality, the observations were lagged four quarters so that the dependent variable (CFO) for a given quarter was predicted by an independent variable from the same quarter one year earlier. As mentioned previously, the sample contained companies from only one industry to produce results that are unobstructed by the counterbalancing effects of industry differences.

To evaluate the comparative predictive abilities of the five models, an analysis is made both of their coefficients of determination (r^2 s) and of their residuals. The analysis of residuals involves examining the percentage prediction errors (PPEs) for the models. Each observation in a model has a PPE, which is computed as follows:

$$\text{PPE} = \frac{\text{Actual CFO} - \text{Predicted CFO}}{\text{Actual CFO}}$$

A model producing relatively low PPEs would be considered a better predictor than one yielding higher PPEs. Summary measures (i.e., means and medians) of the absolute values of the PPEs for the five models are compared to determine the relative predictive accuracies of the models:

Results

Table 1 contains summary statistics for the five univariate CFO prediction models. Notice that each model produces statistically significant F-values, which suggests that each independent variable possesses at least some information content for predicting CFO. This study's purpose is to determine the best predictor; as such, the F-values indicate the strongest relationship exists for the NIDPR variable as it produces the highest F-value. Examining the r^2 s also reveals that NIDPR appears superior as its r^2 of .37 exceeds that achieved by all other models. However, as noted earlier, a model's goodness of fit (r^2) should

Table 1
Summary Statistics for CFO Prediction Models

Summary Measures	NI	NIDPR	WCFO	CFO	Models NCF
F-value	365.70	419.07	159.01	111.19	30.11
(prob. > F)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
r ²	.34	.37	.18	.13	.04
Mean PPE	10.87	6.27	20.44	23.82	36.42
Median PPE	1.43	.93	2.60	2.74	3.57

not be the primary determinant in evaluating its predictive ability. As Akresh and Wallace (1982) note, an analysis of residuals provides more reliable evidence of a model's predictive accuracy than does r^2 .

The analysis of residuals is performed by examining the models' PPEs. Table 1 reveals the means and medians for the absolute values of the PPEs produced by each model. The mean PPE for each model exceeds the median PPE for that same model probably because means can be unduly influenced by a few extreme values (i.e., very large PPEs). Medians are much less affected by extreme values and, thus, are often con-

sidered more representative than means. Regardless of the summary measure used (i.e., means or medians), the NIDPR model again appears superior to all other models because it produces both the lowest mean PPE and the lowest median PPE. Statistical tests comparing the mean and median PPEs of the NIDPR model to the other four models appear in Table 2.

Column one in Table 2 represents a comparison of the mean PPE for the NIDPR model with the means of the other models. For example, the comparison of mean PPEs for the NI and NIDPR models reveals a t-statistic of 1.53 and a significance level for the difference between the

Table 2
Tests of Significance for PPEs of NIDPR Compared to Other Models

Model	Comparison of means using t-statistics	Comparison of medians using two-sample sign test
NI	t = 1.53 prob. > t = .1255	NIDPR < NI 70.83% NIDPR > NI 29.17% prob. level = .0000
WCFO	t = 1.70 prob. > t = .0867	NIDPR < WCFO 80.56% NIDPR > WCFO 19.44% prob. level = .0000
CFO	t = 1.96 prob. > t = .0497	NIDPR < CFO 77.92% NIDPR > CFO 22.08% prob. level = .0000
NCF	t = 2.49 prob. > t = .0127	NIDPR < NCF 77.64% NIDPR > NCF 22.36% prob. level = .0000

means of .1255, suggesting that the mean PPEs for these two models do not differ significantly. Notice, however, that the t-statistics for the remaining three models (i.e., WCFO, CFO, and NCF) indicate that their mean PPEs differ by traditional standards of significance from the mean PPE for the NIDPR model. That is, each one differs at a .10 level of significance or better.

As mentioned earlier, the median PPEs may be more representative measures of the models' predictive accuracies than the mean PPEs. Column two in Table 2 presents the results of a two-sample sign test conducted for each of the four models' PPEs in relation to the PPEs for the NIDPR model. A two-sample sign test is used to determine whether the median of the difference between two sets of values is zero. The test requires paired observations and essentially compares the values for each paired observation within two groups to determine the number of instances when one group's value is higher or lower than the other group's value. It assumes there is no *a priori* reason for one group's values to be higher or lower than the other group's values, which is the case in the present study.

For example, Table 2 shows that the NIDPR model's PPEs were lower than the NI model's PPEs for 70.83% of the observations and higher for only 29.17% of the observations. In essence, the test demonstrates that the NIDPR model predicts better (i.e., has lower PPEs overall) than the NI model and is significantly better at a .0000 level of significance. Similarly, the two-sample sign test for the PPEs for each of the other models in relation to the PPEs for the NIDPR model reveals that the NIDPR model outperforms each model at a statistically significant level.

All methods of comparing the predictive abilities of the models (i.e., comparing r^2 s, mean PPEs, and median PPEs) demonstrate that NIDPR predicts better than any other single predictor tested. Perhaps the most important comparison for evaluating the models' predictive accuracies (i.e., the test of median PPEs) shows that the prediction results achieved by the NIDPR model are better at statistically significant levels.

Thus, unlike previous cash flow prediction studies that often drew contradictory and inconclusive results, this study clearly suggests that, for the sample of companies examined, one predictor variable consistently outperforms all others tested.

Summary and Conclusions

In its Concepts Statement No. 1 (1978), the FASB stated its belief that accrual basis measures are better predictors of future cash flows than are cash basis measures. This statement spawned several studies as researchers compared the predictive abilities of accrual earnings measures and cash flow measures. Their results were largely contradictory and, thus, inconclusive. The present study identified several factors that may have driven the contradictory findings of the prior studies and adjusted certain research constructs in an attempt to improve upon their findings.

Rather than comparing the predictive abilities of only two measures (i.e., accrual earnings and CFO), the present study evaluated the predictive abilities of five variables on a continuum ranging from income before extraordinary items to the net change in cash during the period. To avoid the counterbalancing effects that may be created by examining multiple industries, models were developed for only one industry, the petroleum industry. One predictor variable, earnings before extraordinary items plus depreciation and amortization, outperformed all others in every comparison of predictive ability. Thus, for the companies tested in this sample, the results appear conclusive. The best predictor of future operating cash flows seems not to be a pure measure of either accrual earnings or cash flows, but rather a hybrid measure containing elements of both.

Suggestions for Future Research

The current study examined cash flow predictions for companies in one industry (the petroleum industry) and found that NIDPR consistently outperformed all other predictors. Although NIDPR was not consistently better than

other measures in the Bowen et al. (1986) study, they did find some evidence for NIDPR in their inter-industry sample of firms. Further research in other industries would assist in answering the contention that the usefulness of cash flow predictors may be industry specific. In particular, the present study could be replicated in a different industry or industries to determine if NIDPR's superior predictive ability transcends industry boundaries.

Also, the models in the present study were developed with pooled intertemporal data for 30 companies with no analysis made of the individual companies. This kept the methodology at least partially consistent with prior research. Future research could develop unique time-series models for each company in a sample to determine whether the superiority of given cash flow predictors is company specific. Such models could be developed for companies both within and between industries to further evaluate industry effects. □

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Notes