Forecasting Cash Flows: A Comparison of Prediction Models Within and Between Industries

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Abstract

Accurately predicting future cash flows is important for aiding executive, creditor, and investor decisions. This study compares the predictive ability of earnings and a continuum of cash flow measures within and between the petroleum, specialty retail, and high-tech industries. The results of our within-industry regression analysis indicate that current operating cash flows, calculated in accordance with Codification 230 (formerly SFAS 95), are a better predictor of subsequent operating cash flows than are other commonly used indicators, net income, net income plus depreciation, and working capital from operations. We also demonstrate conditions

Introduction

Providing information that is useful for projecting future operating cash flows (CFO) is globally recognized as a key objective of financial reporting. Assessing prospective CFO is useful for predicting financial distress, assessing the risk, size, and timing of loan decision, predicting credit ratings, valuing closely held companies, and providing incremental information in securities markets (Bowen et al. 1986). The Financial Accounting Standards Board (FASB 1978) states that financial reporting should provide information to help investors, creditors, and others assess the amounts, timing, and uncertainty of prospective net cash inflows related to the enterprise in its Concepts Statement No. 1. Similarly, the International Accounting Standards Board states in their Framework for the Preparation and Presentation of Financial Statements that all user groups are interested in the ability of an enterprise to generate cash and cash equivalents and of the timing and certainty of those future cash flows (Deloitte 2009).

Although the importance of providing information for the forecasting of CFO is globally accepted, the choice of forecasting models is not clear. FASB (1978) asserted that information about current earnings and its components is generally more predictive of future CFO than are current CFO. Although FASB's statement was made without proof, over thirty years of empirical evidence has neither confirmed nor denied its veracity. This study extends the research stream spawned by FASB's assertion by investigating whether current earnings, current CFO (as calculated in accordance with Codification 230), or other common adjusted earnings measures are the better predictors of future CFO. We also investigate whether industry-specific forecast models are superior to general forecast models in predicting future CFO.

Prior research has considered the possibility that the predictive ability of earnings versus CFO could be impacted by industry membership. Dechow et al. (1998) state that there are systematic differences across industries due to differences in their trade and operating cycles, and due to differences in their investment, financing, and operating activities. Correlations across their 59 industry portfolios, however, are similar to the correlations for their entire sample. Recognizing that the types and mix of accruals are likely to vary by industry, Barth et al. (2001) estimate disaggregated earnings models for thirteen industries. Similar to Dechow et al., their results are consistent across industries. Jordan and Waldron (2001) restrain their sample of firms to the petroleum industry to minimize industry effects. Their results, however, are once again comparable to Bowen el al.'s (1986) cross-industry sample where they find that NIDPR is consistently one of the best two predictors of CFO. Both Lorek and Willinger (1996) and Farshadfar et al. (2008) recognize that industry membership could be a potential confounding variable in forecast models and call for an industry control in future research to better understand the predictive ability of CFO versus earnings.

Unlike the prior studies that did not find an industry effect, Stammerjohan & Nassiripour (2001) find that the superiority of forecast models varies when industry membership is considered. Kim and Kross (2005) also find an industry effect when the industry is increasingly conservative (lower level of accumulated nonoperating accruals), but find no difference in the predictive ability of earnings and CFO relating to industries with increasing operating cycles compared to industries whose operating cycles were not increasing.

Our study expands upon Jordan and Waldron (2001) by comparing the predictive abilities of earnings and CFO measures not only within the

petroleum (PET) industry but also within the specialty retail (SR) and high-tech (HT) industries. We chose these additional industries for their similarities and differences. While the PET and SR industries are more mature than the HT, PET and HT have higher growth rates and are more volatile than is the SR industry. We analyze a sample of 5,750 firm-years for U.S. firms from the PET, SR, and HT industries from 1998 to 2007. We first use within-industry and within-sample period univariate regression models to compare the abilities of earnings, NIDPR, working capital from operations, and CFO to predict subsequent CFO. We then use within-industry models to calculate out-of-sample period absolute prediction errors (APEs) to further test the relative abilities of the four measures to predict future CFO. Finally, we use both within-industry and out-of-industry models to calculate out-of-sample period absolute prediction errors (APEs) to test the importance of industry designation in making accurate predictions. Our study avoids the noise inherent in the calculated measures of CFO found in much of the prior literature by using cash flows from operating activities reported on the Statement of Cash Flows under Codification 230.

Our findings do not support FASB's assertion that earnings predict future CFO better than do current CFO. Our results indicate that the best predictor of future CFO is current CFO across all three industries. Further, we find that while industry-specific forecast models out-perform the more general models for the older PET and SR industries, this finding does not carry over to the younger HT industry. Finally, further analysis indicates that some of the within-industry superiority disappears when the sample is restricted to mature firms and when the sample is restricted to larger firms. Our results suggest that the superiority of CFO prediction models may be dependent on industry stability and size, rather than industry membership alone.

The remainder of the paper is organized as follows. Section II reviews the prior literature. Section III describes the research methodology, Section IV reports the results of our analysis, and Section V concludes and summarizes the study.

Literature Review

Early studies, prior to the adoption of Codification 230 (FASB 1987), relied on calculated measures of CFO. The CFO measure used by Greenberg et al. (1986) begins with earnings and makes adjustments for noncash items, changes in current assets (except cash) and changes in current liabilities (excluding the current portion of long-term debt). They conclude that earnings are a better predictor of future CFO than are current

CFO based on separate one-variable tests of the linear relationships between current earnings/current CFO and future CFO. Bowen et al. (1986), compare the predictive ability of CFO and three other cash flow measures to the predictive ability of earnings. A comparison of median prediction errors finds that NIDPR and WCFO are the best predictors of subsequent CFO. Bowen et al. conclude that their findings do not support FASB's statement regarding current earning's superior predictive ability.

Other studies calculate CFO as operating income before depreciation minus interest minus taxes minus changes in non-cash working capital (e.g. Dechow et al. 1998; Lorek and Willinger 1996). This measure does not contain all the Codification 230 adjustments including net income items not affecting working capital such as amortization of bond premiums or discounts and deferred taxes. Both Dechow et al. and Lorek and Willinger conclude that earnings and their accrual components are better predictors of future CFO than are current CFO. Dechow et al. (1998) comment that CFO reported on the statement of cash flows are likely to have less measurement error than their calculated measure. Neill et al. (1991) also discuss the superiority of using reported CFO over calculated CFO in models predicting future CFO. Later studies using reported CFO, however, continue to present mixed results (e.g. McBeth 1993; Quirin et al. 1999; Jordan and Waldron 2001; Stammerjohan and Nassiripour 2001; Al-Attar and Hussain 2004; Nikkinen and Sahistrom 2004).

Rather than consider only two predictor variables (e.g. Greenberg et al. 1986, McBeth 1993; and Finger 1994), we follow more recent research and investigate whether the best predictor is at the extreme of the continuum, earnings or CFO, or another measure somewhere in the middle. Accruals, the difference between earnings and CFO, have been used to define both calculated measures of earnings and CFO. Dechow et al. (1998) consider accruals as a component of earnings. They find that current earnings are a better predictor of future CFO than current CFO. They explain that since the difference between earnings and CFO is accruals, earnings' forecasting power beyond CFO is attributable to accruals. Barth et al. (2001) consider the predictive abilities of six specific accrual components. They find that changes in accounts receivable, accounts payable, inventory, depreciation, amortization, and other accruals are significant in predicting future CFO, incremental to current CFO. Their findings indicate that weighting accrual components of earnings greatly enhances the predictive ability of earnings to predict future CFO. Kim and Kross (2005) investigate whether the predictive ability of earnings has increased over time. They find that in addition to the earnings-only models

showing a significant increase over time, the incremental predictive ability of earnings has also increased over time. They explain that the incremental ability of the earnings predictor over the CFO predictor is attributed to accruals. Nikkinen and Sahlstrom (2004) investigate the predictive ability of earnings across accounting environments. They find that the predictability of earnings in forecasting CFO varies across countries according to the quality of their accruals.

Bowen et al. (1986) use accruals to calculate their cash flow measures and conclude that earnings are not superior to cash flow measures in the prediction of future CFO. Instead, they report that the cash flow measures, net income plus depreciation (NIDPR) and working capital from operations (WCFO), are consistently the best predictors of CFO. Following Bowen et al. (1986), Jordan and Wallace (2001) examine the predictability of a continuum of cash flow measures ranging from net income to the change in cash to predict future CFO within the PET industry. They find that their cash flow measure, NIDPR, has the strongest correlation to future CFO. Farshadfar and Brimble (2008) also investigate a continuum of cash flow measures for Australian firms and report that current CFO has more power in predicting future CFO than earnings and other cash flow measures.

Methodology

This research addresses two general research questions:

(1) Are current earnings or adjusted measures of current earnings superior to current CFO in predicting future CFO within the PET, SR, and HT industries? and,

(2) Are industry-specific forecast models superior to general models in predicting future CFO?

To address these questions, we establish the following regression models:

$$CFO_{t+1} = b_0 + b_1 NI_t + e_t \quad (1)$$

$$CFO_{t+1} = b_0 + b_1 NIDPR_t + e_t \quad (2)$$

$$CFO_{t+1} = b_0 + b_1 WCFO_t + e_t \quad (3)$$

$$CFO_{t+1} = b_0 + b_1 CFO_t + e_t \quad (4)$$

Where,

CFO = cash flows from operating activities as reported on the statement of cash flows under Codification 230,
NI = net income before extraordinary items and discontinued operations,
NIDPR = NI plus depreciation and amortization, and
WCFO = working capital from operations calculated as CFO adjusted for changes in current assets (net of changes in cash) and changes in current liabilities.

Consistent with prior literature, each of the variables was deflated by total assets to control for firm size.

We address our first research question by estimating the four linear regression models for each of the three industries using data from 1998 to 2007 to determine the ability of each of the variables to singularly predict CFO one-year ahead. We assess the relative predictive ability by comparing the coefficients of determinations (R^2s) within each industry. We then add support to the reliability of our within-sample period results by using regression coefficients estimated over seven year periods to calculate out-of-sample period APEs in one-year-ahead holdout samples. For example, we estimate the coefficients of each model with 1998-2004 data to calculate the APEs for 2005. We then use 1999-2005 data estimates to calculate the 2006 APEs and 2000-2006 data estimates to calculate the 2007 APEs. We concentrate on the absolute value of the prediction errors because, a priori, we have no reason to expect the prediction errors to have either a positive or negative bias. [i] We address our second research question by comparing the within-industry APEs to APEs produced by models estimated with out-of-industry samples.

We obtain our samples from the Compustat database listing companies who filed with the SEC from 1996-2007.[ii] The PET sample consists of firms identified by SIC codes: 1311 and 2911. The SR sample is comprised of firms identified by SIC codes: 5600, 5621, 5651, 5661, 5700, 5940, 5944, 5945, and 5990. The HT sample consists of firms identified by SIC codes 7370, 7371, 7372, 7373, 7374, and 7377.[iii] After removing firm-year observations with missing data, and total assets less than $1 million, our sample contains 1,603 firm-year observations from the PET industry, 1,057 firm-year observations from the SR industry, and 3,090 firm-year observations for the HT industry.

Table 1 presents descriptive statistics for the regression variables by industry. NI, NIDPR, WCFO, CFO, and total assets are all reported in $millions. The ratio of the undeflated variable divided by total assets is also presented for each of the predictor variables.

Table 1
Descriptive Statistics for Estimation Sample
1998 – 2007

Variable	Mean*	Std Dev	Median*	Deflated Mean**	Std Dev	Deflated Median**
Panel A: Petroleum Industry N=1,603						
NI	720	2,874	4.95	-0.052	0.473	0.037
NIDPR	1,211	4,282	19.67	0.023	0.465	0.110
WCFO	1,228	4,230	23.68	0.088	0.264	0.123
CFO	1,455	4,708	35.53	0.090	0.214	0.126
Total assets	9,664	30,753	343.27			
Panel B: Specialty Retail Industry N=1,057						
NI	57.72	154.16	14.23	0.040	0.148	0.058
NIDPR	99.15	221.30	27.16	0.093	0.149	0.106
WCFO	99.43	295.57	27.23	0.099	0.177	0.115
CFO	102.17	238.04	27.83	0.091	0.133	0.091
Total assets	897.39	1,613.30	307.97			
Panel C: High-Tech Industry N= 3,090						
NI	5.66	433.16	-1.42	-0.237	0.719	-0.044
NIDPR	28.50	487.91	0.32	-0.134	0.755	0.009
WCFO	54.72	441.55	0.71	-0.090	0.664	0.022
CFO	72.01	555.04	1.08	-0.075	0.427	0.031
Total assets	695.25	3,866.92	74.85			

*Amounts are in reported in $millions.
**Deflated amounts are actual amounts divided by total assets.

The descriptive statistics clearly indicate that the undeflated means are driven by much larger firms within each industry because the means far exceed the medians in every case. While the average PET firm is ten times the size of the average SR firm (measured by total assets), the median PET firm is not noticeably larger than the median SR firm. By contrast, while the mean total assets for SR firms and HT firms are similar, the median SR firm is four times larger than the median HT firm. While, on average, the PET and SR firms produce positive deflated CFO, the HT firms do not.

Results

Table 2 reports the regression statistics for the within-sample period estimations. The coefficient column reports the predictor variable slope coefficients and the R^2 column reports the model R^2s. The F-statistics indicate the overall model significance and the p-value column represents the significance levels of the F-statistics. All twelve estimations are highly significant and the R^2s clearly indicate that current CFO are a better predictor of subsequent CFO across all three industries.

Table 2
Comparison of Regression Models Within Industries

Variable	Coefficient	R^{2**}	F-statistic*	p-value
Panel A: Petroleum Industry N=1,603				
NI	0.144	0.100	178.25	0.000
NIDPR	0.158	0.117	211.40	0.000
WCFO	0.340	0.176	341.47	0.000
CFO	0.726	**0.332**	794.56	0.000
Panel B: Specialty Retail Industry N=1,057				
NI	0.322	0.129	156.14	0.000
NIDPR	0.322	0.131	159.03	0.000
WCFO	0.232	0.095	110.89	0.000
CFO	0.398	**0.157**	196.84	0.000
Panel C: High-tech Industry N=3,030				
NI	0.241	0.165	612.16	0.000
NIDPR	0.200	0.124	438.66	0.000
WCFO	0.216	0.113	391.76	0.000
CFO	0.568	**0.291**	1,268.48	0.000

*equal variances not assumed
**bold indicates the model with the highest R^2 within the industry

To substantiate our within-sample period results, we compare out-of-sample period prediction errors. Given the lack of expectation regarding the direction of the prediction errors, we conduct this analysis over the absolute values of the prediction errors (APEs). The APEs are calculated as follows:

APE = ABS(Actual CFO – Predicted CFO) (5)
Where,
Predicted CFO = Forecasted CFO using regression coefficients estimated over the seven years of within-industry data preceding the prediction holdout year,
Actual CFO = Cash flows from operating activities reported under Codification 230 for the prediction year, and
ABS is the absolute value operator.

We report these results in Table 3. The mean APEs are reported by industry and predictor. The p-values represent the significance of the difference in mean APE between the other predictor variables and the "best" predictor variable, CFO. CFO is significantly better than NI and NIDPR for both the PET and HT industries, p=0.032. CFO is also significantly better than WCFO in the HT industry, p=0.001, and marginally better than WCFO for the PET industry, p=0.054. Although CFO, once again, produces the smallest average APE for the SR industry, the APE is not significantly smaller than any of the other mean APEs for this industry.

Table 3
Comparison of Absolute Prediction Errors*
Within Industries

Model	Petroleum N=641		Specialty Retail N=232		High-Tech N=673	
	Mean APE*	**p-value****	**Mean APE**	**p-value**	**Mean APE**	**p-value**
NI	0.107	0.004	0.076	0.426	0.188	0.032
NIDPR	0.104	0.008	0.073	0.758	0.206	0.001
WFCO	0.095	0.054	0.074	0.600	0.207	0.001
CFO	**0.073**	---	**0.071**	---	**0.157**	---

*APEs based on predicted CFO using a forecast model estimated from within-industry observations. Bold indicates the lowest APE within the industry.
** p-values represent the difference in mean APE in a two-tailed test from the best predictor, i.e., lowest mean APE predictor.

We address our second research question, whether the predictive ability of industry-specific forecast models is superior to general forecast models, by comparing the within-industry APEs to APEs produced by models estimated with out-of-industry samples. We estimate four linear regression models for each of the three industries using only out-of-industry data. We then determine the reliability of the general forecast models by using the out-of-industry regression coefficients to calculate out-of-sample period APEs as described in model (5). The differences in mean APEs between the within-industry and out-of-industry estimations provide a test of our second research question.

We report these results in Table 4. The "Out-of-Industry Mean APE" column reports the mean APEs resulting from the out-of-industry predictions. The "Within-Industry Mean APE" column reports the mean APEs resulting from the within-industry predictions. The "Diff" column reports the difference in mean APEs, the "t-statistic" column reports the t-statistic regarding the difference, and the p-value represents one-sided tests based on the expectation that the within-industry model should result in smaller APEs.

Consistent with our earlier findings, CFO produces the smallest average APEs as compared to the other predictors even when the model is estimated with out-of-industry data. The results are fully consistent with our expectation of dominance for the within industry models for the PET and SR industries. This result, however, does not hold for the HT industry. Quite surprisingly, the general model estimated with PET and SR data outperforms the within-industry estimations. Although in one-sided tests, we can only conclude that we have not rejected the null, the large p-values

are indicative that these results are quite strong in the opposite direction from our expectations.

To determine whether the instability of one industry might be driving our results rather than just industry membership, we eliminated the HT observations and repeated the within versus out-of-industry tests with only the PET and SR observations. These tests did not produce any significantly superior results for the within-industry models.

Table 4
Comparison of Absolute Prediction Errors
Between Industries

Models	Out-of-Industry Mean APE*	Within Industry Mean APE**	Diff	t-statistic	p-value***
Panel A: Petroleum Industry, N=641					
NI	0.144	0.107	0.037	3.15	0.001
NIDPR	0.153	0.104	0.049	4.17	0.000
WCFO	0.150	0.095	0.055	4.75	0.000
CFO	**0.102**	**0.073**	0.029	2.55	0.005
Panel B: Specialty Retail Industry, N=232					
NI	0.100	0.076	0.024	3.68	0.000
NIDPR	0.114	0.073	0.041	6.19	0.000
WCFO	0.115	0.074	0.040	6.23	0.000
CFO	**0.084**	**0.071**	0.013	1.66	0.049
Panel C: High-Tech Industry, N=673					
NI	0.160	0.188	-0.028	-1.66	0.951
NIDPR	0.161	0.206	-0.045	-2.72	0.997
WCFO	0.158	0.207	-0.049	-2.92	0.998
CFO	**0.130**	**0.157**	-0.027	-1.91	0.972

*APEs based on predicted CFO using a forecast model estimated from out-of-industry observations (observations from the other two industries). Bold indicates the lowest APE.

**APEs based on predicted CFO using a forecast model estimated from within-industry observations. Bold indicates the lowest APE.

***One-sided tests based on the expectation that the within industry model should produce smaller mean APE's than the out-of-industry model.

Finally, to determine the impact of small company size on our results, we re-estimated the within-industry and out-of-industry prediction models over all three industries after increasing minimum total assets to $10 million. We report these results in Table 5.

Consistent with all the results reported above, the CFO model remains the "best" predictor with smaller mean APEs across all 24 estimations. While the within-industry models still prevail for the PET industry, the significance of the within-industry results disappear for the SR industry, and the results remain but in a direction opposite of expectations for the HT industry.

While our results regarding our first research question clearly and consistently indicate that current CFO outperform the other three predictors considered in this study regarding the prediction of future CFO, the results to our second research question are mixed. While we find some evidence suggesting the superiority of within-industry models among our PET and SR results, our HT results, our results obtained after eliminating the HT industry from the out-of-industry tests, and our results obtained after eliminating the smallest firms in our samples all indicate that industry stability and firm size may be as important as industry membership in determining the relative superiority of predictor variables within CFO forecast models.

Table 5
Comparison of Absolute Prediction Errors Between Industries
Total Assets ≥ $10 Million

Models	Out-of-Industry Mean APE*	Within Industry Mean APE**	Diff	t-value	p-value***
Panel A: Petroleum Industry, N=556					
NI	0.103	0.079	0.024	5.34	0.000
NIDPR	0.094	0.071	0.023	5.74	0.000
WCFO	0.100	0.071	0.029	7.24	0.000
CFO	**0.066**	**0.055**	0.010	3.00	0.001
Panel B: Specialty Retail Industry, N=229					
NI	0.081	0.078	0.003	0.53	0.298
NIDPR	0.078	0.074	0.004	0.56	0.289
WCFO	0.081	0.073	0.008	1.34	0.091
CFO	**0.066**	**0.067**	-0.001	-0.16	0.563
Panel C: High-Tech Industry, N=555					
NI	0.093	0.104	-0.011	-1.93	0.973
NIDPR	0.088	0.103	-0.015	-2.69	0.996
WCFO	0.090	0.113	-0.023	-3.89	1.000
CFO	**0.075**	**0.087**	-0.012	-2.16	0.985

*APEs based on predicted CFO using a forecast model estimated from out-of-industry observations (observations from the other two industries). Bold indicates the lowest APE.

**APEs based on predicted CFO using a forecast model estimated from within-industry observations. Bold indicates the lowest APE.

***One-sided tests based on the expectation that the within industry model should produce smaller mean APE's than the out-of-industry model.

Summary and Conclusion

Many studies have tested the validity of FASB's statement regarding the superiority of earnings to CFO for predicting future CFO. The results of prior research, however, have not been conclusive as to which measure is the better predictor. Although a few studies (e.g. Dechow et al. 1998; Barth et al. 2001; Jordan and Waldron 2001) consider the impact of industry membership on their analysis, most failed to separate their samples by industry. The purpose of this paper is to compare the predictive ability of earnings and CFO along a continuum of measures within and between the PET, SR, and HT. The PET industry was chosen to extend the work of Jordan and Waldron (2001). The SR industry was chosen as a complement to the PET industry's maturity and a contrast to the PET industry's high growth rate. The HE industry complements the higher growth rates of the PET industry and contrasts the maturity and stability of the PET and SR industries.

The results of this study do not support FASB's assertion that earnings predict future CFO better than do current CFO. Our results are consistent with prior studies finding that current CFO are the better predictors of future CFO (e.g. Finger 1994; Quin 1999; Jordan et al. 2007; and Farshadfar and Brimble 2008). We find that the best predictor of future CFO, as measured by the coefficient of determination, is current CFO for all three industries in this study. The superiority of the CFO model is also confirmed using out-of-sample period data. The APEs of the CFO model are signifantly lower than the APEs of the other models within the PET and HT industries, and lower, but not significantly so, for the SR industry.

The results of this study do not fully support our expectation that industry-specific forecast models would be superior to general forecast models. Although we find that the models generated within the PET and SR industries have more accurate predictive ability than models generated from out-of-industry data, the models generated within the HT industry do not outperform the out-of-industry models. In addition, when the HT observations are eliminated from the out-of-industry samples, then the PET and SR within-industry models no longer outperform the out-of-industry models. Further, when the smallest firms are removed from our samples, the superiority of the within-industry model for the SR industry disappears even with the HT observations still in the out-of-industry sample. We suggest that the differences in predictive ability may relate to firm size and industry stability, rather than just industry membership alone.

Future research examining CFO prediction for additional industries would enhance the findings of this study. Groups of industries could be compared according to industry effect factors such as maturity and stability, entry barriers, and competitive power to determine which, if any, of these defining industry characteristics specifically contribute to the superiority of industry-specific prediction models. In addition, the impact of organizational characteristics such as firm size and sales growth should be investigated.

The ability to accurately predict a company's future CFO is important to executives, investors, and creditors around the world. The comparative usefulness of CFO versus earnings in the prediction of future CFO affects the prediction of financial distress, the assessment of risk, size, and timing of loan decisions, the prediction of credit ratings, the valuation of closely held companies, and the provision of incremental information in the securities markets. With so much at stake, and continued mixed results, the interest in CFO forecasting research will not soon come to an end

Endnotes

1 The reported results are based on the combined average absolute prediction errors from 2005, 2006, and 2007. Untabulated year by year results are consistent with the reported results.

2 We lose 1996 and 1997 because we require three consecutive years of data to estimate our full set of models.

3 We eliminate companies with ".com" names from our SR sample because they may be more like HT firms than other SR firms.

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