Review of Accounting Studies, 6, 371–385, 2001

Using Asset Turnover and Profit Margin to Forecast Changes in Profitability

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Abstract. Financial statement analysis textbooks advocate disaggregating profitability into asset turnover and profit margin in performing financial analysis. In spite of the prominence of this technique, there is no evidence demonstrating its usefulness in a forecasting context. We provide evidence that disaggregating return on assets into asset turnover and profit margin does not provide incremental information for forecasting the change in return on assets one year ahead, but that disaggregating the change in return on assets into the change in asset turnover and the change in profit margin is useful in forecasting the change in return on assets one year ahead.

Keywords: financial statement analysis, disaggregation, return on assets

One objective of financial statement analysis is to determine firm value. Research suggests that a firm's value is a function of the expected future growth and profitability of the firm (e.g., Ohlson, 1995). In analyzing financial statements, analysts often use current growth and profitability as a starting point for predicting future growth and profitability. Textbooks on financial statement analysis present a variety of simple techniques for analyzing current profitability that may lead to improved forecasts of future profitability. Most commonly, the textbooks present ratio analysis in which return on assets is systematically disaggregated into more specific ratios to provide insights into the firm's profitability. The most fundamental disaggregation, featured prominently in many books (Bernstein and Wild, 1998; Revsine, Collins and Johnson, 1999; Stickney and Brown, 1999), is the decomposition of return on assets into asset turnover and profit margin.[1] Textbooks suggest that calculating the relative contributions of asset turnover (or "asset utilization") and profit margin ("operating performance") to current profitability is useful in providing insights into the firm's strategy. Furthermore, many textbooks also suggest calculating changes in the ratios to track changes in the company's asset utilization and operating performance over time.

Since one purpose of financial statement analysis is to predict future performance, it would be useful to know whether this fundamental disaggregation improves profitability forecasts. Although this simple decomposition is presented as a fundamental building block of financial analysis, there is no evidence in the accounting literature to demonstrate its usefulness for forecasting profitability.[2] Prior research provides evidence on the usefulness of a variety of descriptors in prediciting future profitability; (e.g., Ou, 1990; Abarbanell and

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Bushee, 1997); in many cases, however, the variables do not correspond to those presented in textbooks or seen in analyst reports.

There is, however, a small and growing literature examining the determinants of profitability ratios, in particular, return on equity (ROE) and return on net operating assets (RNOA). Freeman, Ohlson and Penman (1982) show that there is regression toward the mean in ROE and establish that extreme ROEs are more transitory than moderate ones. Fairfield, Sweeney and Yohn (1996) show how the components of earnings in the numerator of ROE can be weighted to improve predictions of ROE one year ahead. Nissim and Penman (2000) provide descriptive evidence on how ROE and its component ratios behave over time. The benefit of this stream of research is that it demonstrates the validity of simple techniques that can be used to improve forecasts of future profitability. Since these techniques relate to what is taught in the classroom and to the key metrics that appear in many analyst reports, the research may provide practical guidance to analysts and instructors.

In this paper, we test whether the fundamental decomposition of return on assets presented in textbooks is useful in a forecasting context. We define return on assets using net operating income (before any financing costs or investment income) in the numerator, and net operating assets (operating assets net of operating liabilities) in the denominator. We examine whether considering the relative contributions of asset turnover and profit margin to total operating profitability improves forecasts of changes in profitability, defined as return on assets, one year ahead. We also test whether the year-to-year changes in asset turnover and profit margin provide incremental information over the change in total return on assets for forecasts of the change in return on assets one year ahead.

Asset turnover measures the firm's ability to generate revenues from its assets while profit margin measures the firm's ability to control the costs incurred to generate the revenues. The level of asset turnover, reflecting the firm's asset utilization, and the profit margin, reflecting the firm's operating efficiency, are in part products of the firm's strategy. For example, discount stores tend to have relatively higher asset turnovers and lower profit margins than luxury or specialty stores. Because these ratios are in part the product of a firm's operating strategy, we don't anticipate that the specific mix of asset turnover and profit margin contributing to a firm's profitability will be informative about changes in its profitability one year ahead. We hypothesize, therefore, that disaggregating a firm's return on assets into asset turnover and profit margin will not provide information for predicting the change in return on assets one year ahead.

Changes in the firm's current profitability can be traced to changes in its asset turnover and changes in its profit margin. A change in asset turnover reflects a change in the productivity of the firm's assets and should, therefore, be useful for predicting future profitability. An increase (decrease) in asset turnover should result in an increase (decrease) in profitability one year ahead. A change in profit margin may reflect a change in operating efficiency or, alternatively, a change in accounting conservatism. Increases (decreases) in profit margin from increases (decreases) in efficiency should result in an increase (decrease) in profitability one year ahead. However, increases (decreases) in profit margin from changes in accounting conservatism should not result in increased (decreased) profitability one year ahead. They may, in fact, result in decreased (increased) profitability. For example, a firm could increase its current profit margin by reducing accounting conservatism and deferring expenses. In this case, future profitability may fall as the deferred costs are expensed. Therefore we

hypothesize that changes in profit margin alone will not provide information about future profitability, since it is not clear whether the change in profit margin is a result of changes in efficiency or changes in accounting conservatism.

We hypothesize, therefore, that the disaggregation of the level of return on assets into asset turnover and profit margin will not improve predictions of the change in profitability, defined as the change in return on assets, one year ahead. On the other hand, we hypothesize that the disaggregation of the change in return on assets into the change in asset turnover and the change in profit margin will improve forecasts of the change in return on assets one year ahead. We hypothesize that the change in asset turnover will be informative about future profitability, while the change in profit margin will not be informative about future profitability.

In performing the tests, we first control for factors that have been found in prior literature to provide information about future profitability. Specifically, we control for the firm's current profitability, current growth and current change in profitability.

We find that disaggregating the current *level* of return on assets into the *level* of asset turnover and the *level* of profit margin is not informative about the change in return on assets one year ahead: regression to the mean in profitability is unaffected by the specific combination of asset turnover and profit margin. These results hold after for controlling regression toward the mean in profitability documented in Freeman, Ohlson and Penman (1982), and for the negative impact of growth in net operating assets on operating profitability. This suggests that, while the mix of asset turnover and profit margin may be informative about the firm's strategy, the mix does not provide information about the change in the firm's profitability one year ahead.

We also find that the *change* in return on assets (prior to disaggregation) provides information for the change in return on assets one year ahead. Decreases in operating profitability signal additional decreases in the subsequent period. More importantly, we find that disaggregating the *change* in return on assets into the *change* in asset turnover and the *change* in profit margin provides incremental information about future profitability. We also find that while the change in asset turnover correlates with the change in future profitability, the change in profit margin does not. The change in "asset utilization" correlates positively with the change in profitability one year ahead. In contrast, changes in "operating efficiency" are uncorrelated with the change in future profitability.

These results provide specific guidance on how asset turnovers and profit margins can be used in forecasting profitability. The current levels of asset turnover and profit margin are uninformative about the future change in profitability. In contrast, changes in asset turnover are leading indicators of changes in future profitability.

These results provide empirical evidence on the usefulness of common analytical techniques presented in most textbooks and taught in many classrooms. They also suggest a straightforward method to improve profitability forecasts. Future research can build on these results to provide more guidance to analysts and instructors about how to use the current financial statements to improve profitability forecasts.

The remainder of the paper is organized as follows. Section 1 describes the data and provides descriptive statistics. Section 2 provides the main empirical results, while Section 3 provides results of additional analyses. Finally, Section 4 provides conclusions and suggestions for future research.

1. Variable Definitions and Descriptive Statistics

Recent research (Ohlson, 1995) shows that the value of a firm can be expressed as a function of the firm's book value and future abnormal earnings, or future return on equity in excess of the cost of capital. Other research (Feltham and Ohlson, 1995) shows that it is the operating activities that yield abnormal earnings. These studies suggest that understanding firm value requires forecasts of future return on operating assets. Following this reasoning, we focus on the prediction of return on net operating assets (RNOA) for the analysis. We test whether the levels of asset turnover and profit margin provide incremental information content over the level of operating profitability for predicting future operating profitability. We also test whether disaggregating the current change in RNOA (ΔRNOA) into the change in ATO (ΔATO) and the change in PM (ΔPM) provides information for forecasting the ΔRNOA one year ahead. We first control for other factors that have been shown to improve profitability forecasts. Following Brooks and Buckmaster (1980) and Freeman, Ohlson and Penman (1982), who show that profitability is mean-reverting, we control for current profitability in the analysis. Lipe (1986) presents evidence on the persistence of different components of earnings, and Fairfield, Sweeney and Yohn (1996) show that profitability forecasts can be improved by adjusting reported income for specific income statement line items. To ensure that the disaggregation captures incremental information to that in the income statement line items, we use operating income before any unusual or nonrecurring items (and before interest and taxes) in the numerator of the profitability measure. In addition, following evidence reported in Sunder (1980), Ou (1990), and Abarbanell and Bushee (1997), showing that capital expenditures have a negative association with subsequent earnings changes, we control for growth in net operating assets in the analysis (ΔNOA).[3] We also include ΔRNOA in the analysis, since our objective is to test whether the disaggregation of ΔRNOA provides incremental information content over the total change in profitability.

We test for incremental information content by conducting out-of-sample forecasting tests. The dependent variable in all the forecasting models is the change in RNOA in year $t + 1$. Model "0", which is a naïve model predicting no change in RNOA, provides a benchmark against which we can test the out-of-sample forecasting power of the control variables. Model 1 includes three control variables, RNOA_t, ΔNOA_t, and ΔRNOA_t. We then disaggregate RNOA_t into ATO_t and PM_t, and disaggregate ΔRNOA_t into ΔATO_t and ΔPM_t to assess their incremental explanatory power for ΔRNOA_{t+1}.[4]

Since profitability is defined as return on net operating assets (RNOA), it is not affected by differences or changes in capital structure. The numerator of RNOA (and profit margin) is operating income after depreciation, defined as sales (net of discounts and allowances) minus bad debt expense, cost of goods sold, selling, general and administrative expenses, research and development expense, and depreciation and amortization expense.[5] The reported RNOA excludes interest, taxes and explicit special and nonrecurring items; changes in profitability therefore reflect changes in core operating profitability, rather than transitory line items.[6]

The denominator of RNOA (and asset turnover) is average net operating assets, defined as operating assets (all assets except cash and marketable securities) minus operating liabilities (all liabilities except interest bearing debt). The numerator of asset turnover (and denominator of profit margin) is sales net of discounts and allowances, but before bad debt expense.

The change in RNOA is disaggregated as follows:

$$\begin{aligned}
\Delta\text{RNOA}_t &= \text{RNOA}_t - \text{RNOA}_{t-1} \\
\Delta\text{RNOA}_t &= \text{ATO}_t * \text{PM}_t - \text{ATO}_{t-1} * \text{PM}_{t-1} \\
\Delta\text{RNOA}_t &= (\text{ATO}_{t-1} + \Delta\text{ATO}_t) * (\text{PM}_{t-1} + \Delta\text{PM}_t) - \text{ATO}_{t-1} * \text{PM}_{t-1} \\
\Delta\text{RNOA}_t &= \text{ATO}_{t-1} * \text{PM}_{t-1} + \Delta\text{ATO}_t * \text{PM}_{t-1} + \text{ATO}_{t-1} * \Delta\text{PM}_t \\
&\quad + \Delta\text{ATO}_t * \Delta\text{PM}_t - \text{ATO}_{t-1} * \text{PM}_{t-1} \\
\Delta\text{RNOA}_t &= \Delta\text{ATO}_t * \text{PM}_{t-1} + \Delta\text{PM}_t * \text{ATO}_{t-1} + \Delta\text{ATO}_t * \Delta\text{PM}_t
\end{aligned}$$

Based on this, we disaggregate ΔRNOA_t into three variables: ΔATO_t, ΔPM_t and ΔINT_t, where the variable labeled ΔATO_t is $\Delta\text{ATO}_t * \text{PM}_{t-1}$, the variable labeled ΔPM_t is $\Delta\text{PM}_t * \text{ATO}_{t-1}$ and the variable labeled ΔINT_t is $\Delta\text{ATO}_t * \Delta\text{PM}_t$. By multiplying ΔATO_t (ΔPM_t) by the prior year's PM (ATO), we allow for cross-sectional differences in the mix of asset turnovers and profit margins. Since raw changes in asset turnover and profit margin may have different implications for future profitability, these adjustments compensate for differences among firms in the mix of asset turnover and profit margin as components of profitability. Thus, the variable labeled change in asset turnover (ΔATO_t) is the change in RNOA_t traceable to the change in asset turnover; and the variable labeled change in profit margin (ΔPM_t) is the change in RNOA_t traceable to the change in profit margin. The variable labled ΔINT_t is the interaction term which the captures the interaction between the change in asset turnover and the change in profit margin. The complete set of variables used in the empirical analysis are defined as follows:

Return on net operating assets (RNOA_t): operating income$_t$/average net operating assets$_t$;

Asset turnover (ATO_t): revenues$_t$/average net operating assets$_t$;

Profit margin (PM_t): operating income$_t$/revenues$_t$;

Operating income (OPINC_t): sales$_t$ − (bad debt expense + cost of goods sold + selling, general and administrative expenses + research and development expense + depreciation and amortization expense)$_t$;

Average net operating assets (NOA_t) = (net operating assets$_t$ + net operating assets$_{t-1}$)/2;

Net operating assets$_t$: net assets$_t$ (equity) − net financial assets$_t$;

Net financial assets$_t$: cash plus short term investments − interest-bearing liabilities$_t$;

Growth in net operating assets$_t$ (ΔNOA_t): (net operating assets$_t$ − net operating assets$_{t-1}$)/ net operating assets$_{t-1}$;

Change in return on net operating assets (ΔRNOA_t): $\text{RNOA}_t - \text{RNOA}_{t-1}$;

Change in asset turnover$_t$ (ΔATO_t): $(\text{ATO}_t - \text{ATO}_{t-1}) * \text{PM}_{t-1}$;

Change in profit margin$_t$ (ΔPM_t): $(\text{PM}_t - \text{PM}_{t-1}) * \text{ATO}_{t-1}$; and

Interaction term$_t$ (ΔINT_t): $\Delta\text{PM}_t * \Delta\text{ATO}_t$.

Included in the tables are all firms with the required data for years $t-1$, t, and $t+1$ on the Compustat Industrial Annual tape for the years 1977–1996. We exclude financial firms with

SIC codes from 6000 to 6999 because separation of their financial and operating activities is artificial. Firms with negative profit margins in year $t-1$ are not included because an increase in asset turnover in year t, multiplied by the lagged profit margin, would be classified as a decrease. The results are valid for firms reporting operating profits (before interest, taxes, and unusual and non-recurring items) in the prior year, but do not necessarily hold for unprofitable firms.[7] For the out-of-sample tests, we delete observations for which the absolute value of ΔRNOA_t, ΔATO_t, or ΔPM_t is greater than 0.5 or for which the absolute value of RNOA_t is greater than 1 to control for outliers. This is an implementable strategy, since the screen for outliers relies on data and a decision rule available at time t. For the in-sample estimation of the forecasting model, we also exclude all observations for which the absolute value of ΔRNOA_{t+1} is greater than 0.5. All the analyses reported in the paper were repeated using centile ranks, by year, of all variables. The analyses were also repeated using the Belsley, Kuh and Welsch (1980) procedure to control for outliers. The results using both of these alternative approaches to control for outliers are comparable to those reported here. The sample size for the model estimation is 9,147 and for the out-of-sample forecasting tests is 14,527.

Table 1 reports the descriptive statistics and the rank correlations for the dependent and explanatory variables. Panel A reports the mean, standard deviation and median for the variables in the analysis. The means and medians are consistent with prior research, although the firms appear to be more profitable than those reported in Nissim and Penman (2000). This is reasonable given that we eliminated firms with negative profit margins. Also, given that the firms in our sample are relatively more profitable, and given that prior research (Freeman, Ohlson and Penman, 1982) shows that there is regression toward the mean in profitability, it is reasonable that the mean and median ΔRNOA_{t+1} is slightly negative for our sample of firms.

Panel B of Table 1 reports the correlations among the variables. Although they do not control for multicollinearity among the variables, these simple correlations suggest that current profitability, profit margin, asset turnover and growth in net operating assets correlate negatively with next period's change in profitability. In addition, the current change in profitability and change in asset turnover correlate positively with next period's change in profitability.

2. Empirical Results

2.1. Do Asset Turnover and Profit Margin Provide Information About Future Profitability?

Table 2 reports in-sample regression results. The regression includes observations from the period 1978–1986. We investigate whether disaggregating current RNOA into ATO and PM or disaggregating ΔRNOA into ΔATO and ΔPM is informative about the change in RNOA one year ahead. The regressions include, as control variables, current RNOA, growth in net operating assets (ΔNOA) and the change in RNOA (ΔRNOA) as explanatory variables for the change in RNOA one year ahead. The t-statistics are reported in parentheses under the mean coefficient. The table presents the results of pooled regressions. We also ran individual regressions by year. The results, not reported here, are comparable to those in the table.

Table 1. Descriptive statistics and correlations 1978–1996, $n = 23{,}674$.

Panel A: Descriptive statistics

Variable	Mean	Standard Deviation	Median
$\Delta RNOA_{t+1}$	−0.005	0.094	−0.001
$\Delta OPINC_{t+1}$	0.018	0.272	0.017
$RNOA_t$	0.172	0.160	0.150
ATO_t	2.25	2.27	1.85
PM_t	0.092	0.532	0.089
ΔNOA_t	0.097	0.320	0.072
$\Delta RNOA_t$	−0.005	0.093	−0.001
ΔATO_t	−0.005	0.044	−0.0009
ΔPM_t	−0.004	0.082	0.0004
Δ INT_t	0.003	0.019	0.0002

Panel B: Spearman correlations

	Explanatory Variables									
	$RNOA_t$	ATO_t	PM_t	ΔNOA_t	$\Delta RNOA_t$	ΔATO_t	ΔPM_t	ΔINT_t	$\Delta RNOA_{t+1}$	$\Delta OPINC_{t+1}$
$RNOA_t$	**1.00**	**0.44**	**0.38**	**0.23**	**0.24**	**0.08**	**0.26**	**−0.05**	**−0.22**	**0.02**
ATO_t		**1.00**	**−0.40**	**0.08**	**0.06**	**0.05**	**0.07**	**0.04**	**−0.08**	**0.11**
PM_t			**1.00**	**0.19**	**0.15**	**0.05**	**0.17**	**−0.12**	**−0.20**	**−0.09**
ΔNOA_t				**1.00**	**−0.19**	**−0.31**	**0.00**	**−0.02**	**−0.30**	**−0.01**
$\Delta RNOA_t$					**1.00**	**0.70**	**0.80**	**−0.08**	**0.07**	**0.04**
ΔATO_t						**1.00**	**0.25**	**−0.10**	**0.14**	**0.07**
ΔPM_t							**1.00**	**−0.15**	**−0.01**	**0.03**
ΔINT_t								**1.00**	**0.03**	**0.01**

All correlations in bold are significant at the one percent significance level.
Return on net operating assets ($RNOA_t$): operating $income_t$/average net operating $assets_t$
Asset $turnover_t$ (ATO_t): ($revenues_t$/average net operating $assets_t$)
Profit $margin_t$ (PM_t): (operating $income_t$/$revenues_t$)
Operating $income_t$: sales minus cost of goods sold, selling, general and administrative and depreciation expense
Average net operating $assets_t$ = (net operating $assets_t$ + net operating $assets_{t-1}$)/2
Net operating $assets_t$: total assets less cash and cash equivalents minus total liabilities less interest-bearing $debt_t$
Change in return on net operating assets ($\Delta RNOA_t$): $RNOA_t - RNOA_{t-1}$
Change in asset $turnover_t$ (ΔATO_t): [($revenues_t$/average net operating $assets_t$) − ($revenues_{t-1}$/average net operating $assets_{t-1}$)] * PM_{t-1}
Change in profit $margin_t$ (ΔPM_t): [(operating $income_t$/$revenues_t$) − (operating $income_{t-1}$/$revenues_{t-1}$)] * ATO_{t-1}
Interaction $term_t$ (ΔINT_t): ΔATO_t * ΔPM_t

Model 1 includes only the control variables. All three explanatory variables, $RNOA_t$, ΔNOA_t, and $\Delta RNOA_t$, are significant and have the expected signs. The negative coefficient on $RNOA_t$ confirms regression toward the mean in profitability. The negative coefficient on growth suggests, consistent with prior research, that growth in net operating assets is associated with lower profitability one year ahead. The positive coefficient on $\Delta RNOA_t$ shows positive correlation in year-to-year changes in profitability.

Model 2 disaggregates current RNOA into ATO_t and PM_t. (Note that current RNOA is the product, not the sum, of asset turnover and profit margin, so all three variables are included

Table 2. Regression of change in RNOA_{t+1} on profitability, growth, and change in RNOA_t and disaggregations of RNOA_t and ΔRNOA_t 1976–1986, $n = 9{,}147$.

Model 1: $\Delta\text{RNOA}_{t+1} = \alpha_1 + \beta_{11}\,\text{RNOA}_t + \beta_{12}\,\Delta\text{NOA}_t + \beta_{13}\,\Delta\text{RNOA}_t + e_{t+1}$
Model 2: $\Delta\text{RNOA}_{t+1} = \alpha_2 + \beta_{21}\,\text{RNOA}_t + \beta_{22}\,\text{ATO}_t + \beta_{23}\,\text{PM}_t + \beta_{24}\,\Delta\text{NOA}_t + \beta_{25}\,\Delta\text{RNOA}_t + e_{t+1}$
Model 3: $\Delta\text{RNOA}_{t+1} = \alpha_3 + \beta_{31}\,\text{RNOA}_t + \beta_{32}\,\Delta\text{NOA}_t + \beta_{33}\,\Delta\text{ATO}_t + \beta_{34}\,\Delta\text{PM}_t + \beta_{35}\,\Delta\text{INT}_t + e_{t+1}$

Model	α	RNOA_t	ATO_t	PM_t	ΔNOA_t	$\Delta\,\text{RNOA}_t$	ΔATO_t	ΔPM_t	ΔINT_t	R^2
1	0.0270	−0.1467			−0.0732	0.0570				0.1045
	(16.24)	(−21.85)			(−17.74)	(5.24)				
2	0.0266	−0.1492	0.0006	−0.0047	−0.0729	0.0593				0.1046
	(12.68)	(−19.35)	(1.42)	(−0.39)	(−17.62)	(5.35)				
3	0.0247	−0.1403			−0.0671		0.1799	0.0042	0.1349	0.1082
	(14.53)	(−20.71)			(−15.83)		(8.08)	(0.28)	(2.47)	

See Table 1 for variable definitions.
t-statistics are reported in parentheses.

in the regression.) The coefficients on current ATO and current PM are both insignificant. This suggests that neither current asset turnover nor current profit margin adds information over current RNOA. The results suggest that the change in RNOA one year ahead is not related to the underlying mix of asset turnover and profit margin.[8]

Next we investigate whether changes in asset turnover and profit margin are informative about changes in future profitability. Model 3 disaggregates ΔRNOA_t into ΔATO_t, ΔPM_t and ΔINT_t to determine if the components of ΔRNOA_t provide information about the change in RNOA one year ahead. The change in asset turnover has a positive and significant coefficient, while the coefficient on ΔPM_t is not significant.[9] The coefficient on ΔINT_t is positive and significant. We also ran a regression, not reported here, with ΔINT_t excluded from the model. The coefficient on ΔATO_t is positive and significant and the coefficient on ΔPM_t is still not significant. The results suggest that the change in the asset turnover ratio provides information about future profitability, and that the change in profit margin, alone, provides no information about future profitability.[10]

Tables 3 and 4 report on the out-of-sample forecasting accuracy from each of the models for forecasting the change in RNOA one year ahead. The coefficients used in the out-of-sample forecasts are those reported in Table 2 for the period 1978–1986 to forecast ΔRNOA_{t+1} for the period 1987–1996.

To test whether the base model is useful, we first test whether Model 1 improves forecast accuracy over Model 0, a naïve model that assumes no change in RNOA one year ahead. Model 2 disaggregates RNOA_t into ATO_t and PM_t; Model 3 disaggregates ΔRNOA_t into ΔATO_t, ΔPM_t and ΔINT_t.

Table 3 reports the median, mean and standard deviation of each forecast and of the absolute forecast errors from each model. The median absolute forecast error for the naïve model is 0.0336. The median forecast from Model 1, which includes only the control variables, is −0.0049 and the median absolute forecast error is 0.0332. Model 2, which disaggregates RNOA into asset turnover and profit margin, reduces the absolute forecast error to 0.0326; Model 3, which disaggregates ΔRNOA_t, yields an absolute forecast error of 0.0305.

Table 3. Descriptive statistics on forecasts and forecast errors from out-of-sample forecasts of change in $RNOA_{t+1}$ 1986–1996, $n = 14{,}527$.

Model 0: $\Delta RNOA_{t+1} = 0$
Model 1: $\Delta RNOA_{t+1} = \alpha_1 + \beta_{11}\, RNOA_t + \beta_{12}\, \Delta NOA_t + \beta_{13}\, \Delta RNOA_t$
Model 2: $\Delta RNOA_{t+1} = \alpha_2 + \beta_{21}\, RNOA_t + \beta_{22}\, ATO_t + \beta_{23}\, PM_t + \beta_{24}\, \Delta NOA_t + \beta_{25}\, \Delta RNOA_t$
Model 3: $\Delta RNOA_{t+1} = \alpha_3 + \beta_{31}\, RNOA_t + \beta_{32}\, \Delta NOA_t + \beta_{33}\, \Delta ATO_t + \beta_{34} \Delta PM_t + \beta_{35}\, \Delta INT_t$

	Forecast			Absolute Forecast Error		
Model	Median	Mean	Std. Dev.	Median	Mean	Std. Dev.
0	0	0	0	0.0336	0.0709	0.2054
1	−0.0049	−0.0076	0.0395	0.0332	0.0665	0.1926
2	−0.0039	−0.0059	0.0395	0.0326	0.0662	0.1927
3	−0.0062	−0.0112	0.0336	0.0305	0.0564	0.1072

See Table 1 for variable definitions.
The coefficients for the forecasts are those reported in Table 2 for the 1977 to 1986 period. The models are used to forecast the change in RNOA one year ahead in the period 1987 to 1996.
Absolute forecast error is the absolute value of the difference between the actual and forecasted change in RNOA one year ahead.

Table 4. Out-of-sample tests of forecast improvements from alternative modes to forecast $\Delta RNOA_{t+1}$ 1987–1996, $n = 14{,}527$

Model 0: $\Delta RNOA_{t+1} = 0$
Model 1: $\Delta RNOA_{t+1} = \alpha_1 + \beta_{11}\, RNOA_t + \beta_{12}\, \Delta NOA_t + \beta_{13}\, \Delta RNOA_t$
Model 2: $\Delta RNOA_{t+1} = \alpha_2 + \beta_{21}\, RNOA_t + \beta_{22}\, ATO_t + \beta_{23} PM_t + \beta_{24}\, \Delta NOA_t + \beta_{25}\, \Delta RNOA_t$
Model 3: $\Delta RNOA_{t+1} = \alpha_3 + \beta_{31}\, RNOA_t + \beta_{32}\, \Delta NOA_t + \beta_{33}\, \Delta ATO_t + \beta_{34}\, \Delta PM_t + \beta_{35}\, \Delta INT_t$

Models Compared		All Observations	Firms Sorted by Absolute Difference in Forecasts[a]		
			Largest 25%	Middle 50%	Smallest 25%
1 vs. 0	Difference in forecasts[a]	0.0024***	0.0430***	0.0139***	0.0031***
	Forecast improvement[b]	0.0014***	0.0252***	0.0049***	−0.00001
		0.0027***	0.0089***	0.0011***	−0.00002
2 vs. 1	Difference in forecasts[a]	0.0094***	0.0020***	0.0094***	0.0026***
	Forecast improvement[b]	−0.0014***	−0.0096***	−0.0021	−0.0012***
		−0.0008***	−0.0026***	−0.0002	−0.0006***
3 vs. 1	Difference in forecasts[a]	0.0020***	0.0066***	0.0020***	0.0005***
	Forecast improvement[b]	0.0003***	0.0038***	0.0011***	0.00006***
		0.0002***	0.0004***	0.00016***	0.00004***

Model coefficients estimated using the coefficients from Table 2 for the period 1978–1986; forecast improvements calculated using 1987–1996 data.
[a]The absolute difference in forecasts between the two models.
[b]Reported medians (on the top) and means (on the bottom) are for paired differences in absolute forecast errors for firm j in year t using the lower numbered model compared to the higher numbered model; positive differences indicate that the higher numbered model is superior.
***,** significantly different from zero at the 1%, 5% level, respectively.

In Table 4 we report out-of-sample tests of forecast improvements from each model after pairing observations for each forecast model. The table reports the median absolute difference in forecasts for each of the sets of models compared. The table also reports the median (on top) and mean (on bottom) forecast improvement from using the higher numbered model compared to the lower numbered model. The first column reports the results for the full sample of firms. The table also reports the forecast improvements based on the absolute difference in forecasts. For some firm/year observations, the disaggregated model may have little effect on the forecast of future ΔRNOA (e.g., for cases where the relative contributions of the change in asset turnover and the change in profit margin to ΔRNOA are close to the average). In these cases, using the disaggregated model cannot be expected to improve forecast accuracy significantly. Of greater importance is whether the disaggregated model improves forecasts when the disaggregation adds significant information. To investigate this issue, statistics reported in Table 4 are also reported for three subsets of the observations, sorted by the absolute value of the difference in forecasts.

The results for Model 1 versus Model 0 suggest that a model that incorporates current profitability, current growth and the current change in profitability significantly improves forecasts of ΔRNOA one year ahead over a naïve model. The median overall improvement of 0.0014 suggests that the control model is significantly more accurate than assuming no change in RNOA one year ahead. Model 1 is significantly more accurate than Model 0 for the full sample and for all firms except those in the lowest 25% based on absolute forecast differences. Furthermore, for those observations in the top 25% based on absolute forecast differences, Model 1 improves forecast accuracy by 0.025. These out-of-sample tests confirm that the control model provides a reliable signal about changes in future profitability.

The table next reports the forecast improvement from Model 2 versus Model 1. The overall results and the results by forecast differences suggest that disaggregating RNOA into ATO and PM is not useful for improving forecasts of the change in RNOA one year ahead. In fact, Model 2 yields significantly less accurate forecasts than Model 1 for the full sample and for the observations with very small and large absolute forecast differences. We conclude, therefore, that disaggregating RNOA into ATO and PM is not useful in a forecasting context.

The table next reports the forecast improvements from Model 3 versus Model 1. The results show significant improvement from Model 3 over Model 1 for the full sample and for each subgroup based on absolute forecast differences. For observations with the largest forecast differences, Model 3 improves the forecast accuracy by 0.0038. The results suggest that disaggregating ΔRNOA into its components is useful for forecasting ΔRNOA one year ahead.

2.2. Does the Change in Asset Turnover Predict the Change in Operating Income?

From a practical point of view, we note that most analysts forecast changes in income rather than changes in RNOA. We test, therefore, whether disaggregating RNOA or ΔRNOA improves forecasts of operating income one year ahead. Table 5 reports the results for the

Table 5. Regression of change in operating income$_{t+1}$ on RNOA$_t$, growth, change in RNOA$_t$ and disaggregations of RNOA$_t$ and the change in RNOA$_t$.

Model 0: $\Delta\text{OPINC}_{t+1} = 0$
Model 1: $\Delta\text{OPINC}_{t+1} = \alpha_1 + \beta_{11}\,\text{RNOA}_t + \beta_{12}\,\Delta\text{NOA}_t + \beta_{13}\,\Delta\text{RNOA}_t$
Model 2: $\Delta\text{OPINC}_{t+1} = \alpha_2 + \beta_{21}\,\text{RNOA}_t + \beta_{22}\,\text{ATO}_t + \beta_{23}\,\text{PM}_t + \beta_{24}\,\Delta\text{NOA}_t + \beta_{25}\,\Delta\text{RNOA}_t$
Model 3: $\Delta\text{OPINC}_{t+1} = \alpha_3 + \beta_{31}\,\text{RNOA}_t + \beta_{32}\,\Delta\text{NOA}_t + \beta_{33}\,\Delta\text{ATO}_t + \beta_{34}\,\Delta\text{PM}_t + \beta_{35}\,\Delta\text{INT}_t$

Panel A: In-sample regression results; coefficients estimated using data from 1978–1986

Model	α	RNOA$_t$	ATO$_t$	PM$_t$	ΔNOA$_t$	ΔRNOA$_t$	ΔATO$_t$	ΔPM$_t$	ΔINT$_t$	R^2
1	0.0019	0.0465			0.0097	0.0802				0.0149
	(1.12)	(6.91)			(2.4)	(7.18)				
2	0.0010	0.0421	0.0007	0.0010	0.0098	0.0812				0.0151
	(0.79)	(5.55)	(1.75)	(0.08)	(2.35)	(7.22)				
3	0.0010	0.0482			0.0132		0.1500	0.0461	0.1745	0.0164
	(0.60)	(7.14)			(3.10)		(6.91)	(1.98)	(2.78)	

Panel B: Out-of-sample forecasting results, coefficients reported in Panel A are used to forecast $\Delta OPINC_{t+1}$ for the period 1987–1996

	Forecast			Absolute Forecast Error		
Model	Median	Mean	Std. Dev.	Median	Mean	Std. Dev.
0	0	0	0	0.0330	0.0577	0.0935
1	0.0094	0.0099	0.0115	0.0297	0.0559	0.0941
2	0.0017	0.0016	0.0075	0.0323	0.0572	0.0936
3	0.0086	0.0098	0.0117	0.0298	0.0558	0.0938

Panel C: Forecast Improvements

Models Compared			Firms Sorted by Absolute Difference in Forecasts[a]		
		All Observations	Largest 25%	Middle 50%	Smallest 25%
1 vs. 0	Difference in forecasts[a]	0.0099***	0.0207***	0.0099***	0.0037***
	Forecast improvement[b]	0.0025***	0.0160***	0.0056***	0.00014***
		0.0017***	0.0047***	0.0011***	0.00017***
2 vs. 1	Difference in forecasts[a]	0.0074***	0.0140***	0.0074***	0.0035***
	Forecast improvement[b]	−0.0027***	−0.0112***	−0.0044***	−0.0012***
		−0.0013***	−0.0035***	−0.0005***	−0.0005***
3 vs. 1	Difference in forecasts[a]	0.0012***	0.0081***	0.0027***	0.0006***
	Forecast improvement[b]	0.00009***	0.0024***	0.0005***	0.00001**
		0.00009***	0.0003***	0.00005***	0.00001**

t-statistics are reported in parentheses.
See Table 1 for variable definitions.
Model coefficients estimated using the coefficients from Table 2 for the period 1978–1986; forecast improvements calculated using 1987–1996 data.
[a]The absolute difference in forecasts between the two models.
[b]Reported medians (on the top) and means (on the bottom) are for paired differences in absolute forecast errors for firm j in year t using the lower numbered model compared to the higher numbered model; positive differences indicate that the higher numbered model is superior.
***,** significantly different from zero at the 1%, 5% level, respectively.

regression with the change in operating earnings, scaled by lagged net operating assets (ΔOPINC$_{t+1}$), as the dependent variable. By using lagged NOA in the denominator of the dependent variable, we can focus on the information content of the disaggregations for operating income without reference to the information content for the denominator of the profitability ratio.[11]

Panel A reports the in-sample regression results using observations from 1978 to 1986. The pooled results are reported in the table. The results for individual yearly regressions, not reported here, are comparable to those in the table. Model 1 includes only the control variables: current RNOA, current growth and the current change in RNOA. Model 2 disaggregates RNOA into ATO and PM while Model 3 disaggregates ΔRNOA into ΔATO and ΔPM. For Model 1, the coefficient on RNOA$_t$ is positive and significant, indicating that changes in operating income correlate positively with current RNOA. The coefficient on ΔNOA$_t$ is also significant and positive, demonstrating that while growth reduces next period's return on net operating assets, it increases next period's operating income. The coefficient on ΔRNOA$_t$ is also positive and significant, suggesting that firms with increased RNOA in the current year are more likely to report increased operating income in the following year.

Model 2, which disaggregates RNOA, is consistent with the evidence in the preceding tables. The coefficients on ATO and PM are not significant. Model 3, which disaggregates ΔRNOA, is also consistent with the results for predicting the change in RNOA one year ahead. The results, not reported here, of a regression in which ΔINT$_t$ is excluded from the model, show that the coefficient on ΔATO$_t$ is positive and significant while the coefficient on ΔPM$_t$ is not significant. This suggests that disaggregating the change in return on net operating assets may provide a practical signal for analysts forecasting operating income.

Panel B reports on the forecasts and absolute forecast errors from each of the models. Model 0 forecasts that the change in OPINC will be zero. The results show that the median absolute forecast errors are smaller for Model 1 versus Model 0 but that the median forecast errors are larger for Model 2 versus Model 1. The absolute forecast errors are smallest for Model 3. Specific tests of forecast accuracy improvements are reported in Panel C.

Panel C reports on the paired forecast improvements. The results show that Model 1 significantly improves forecast accuracy over Model 0 overall and for each of the forecast difference subgroups. The results also show that Model 2 significantly reduces forecast accuracy relative to Model 1 overall and for observations in each of the subgroups. Model 3 increases forecast accuracy over Model 1 for the full sample and for each of the subsamples based on absolute forecast differences. Taken overall, the results suggest that disaggregating ΔRNOA is useful in improving predictions of changes in OPINC one year ahead.

3. Additional Analyses

We performed additional analyses to provide insight into the conditions under which the change in asset turnover provides information about future profitability. We ran regressions within one digit and two digit SIC codes. By performing the analysis within SIC codes, the results give some insight into the robustness of the results across firms with different operating environments. We found that the results regarding the incremental information

content of the change in asset turnover are remarkably robust. The coefficients on RNOA and ΔNOA_t are negative and significant and the coefficient on ΔATO_t is positive and significant in each industry. The results suggest that the results are robust across a variety of operating environments.

We also performed analyses separately for firms separated into deciles based on RNOA, PM, ΔRNOA, ΔPM and ΔNOA. In tests not reported here, we ran separate regressions for firms separated into deciles (formed within years) by each of these variables. We found that the disaggregation of ΔRNOA provides incremental information for eight of the ten RNOA and ΔNOA deciles and that the improvement does not appear to be related to the level of growth or profitability. We found that the disaggregation of ΔRNOA provides incremental information for six of the ΔRNOA deciles and the improvement does not appear to be related to the change in profitability. We also found that the disaggregation of ΔRNOA provides incremental information in six of the ΔPM deciles, and the significant improvement occurs in deciles one through three and deciles eight through ten. Thus, the information in the disaggregation appears to be greatest for relatively higher and lower values of ΔPM, although the results do not appear to be driven by ΔPM outliers. The results hold for seven of the PM deciles and the improvement does not appear to be related to the level of profit margin. These separate regression results suggest that the results are robust and do not appear to be due to outliers with respect to profit margin, growth or profitability.

4. Conclusion and Implications for Financial Statement Analysis

The evidence clearly demonstrates that the disaggregation of the change in return on net operating assets provides information about future profitability. The disaggregation provides incremental information over other simple indicators of future profitability, including the level of current profitability, growth in net operating assets, and the presence of unusual and/or non-recurring items in current profitability. Out-of-sample forecasting results confirm that the disaggregation can be used to improve profitability forecasts.

The results provide educators and analysts with a strong empirical rationale for a simple technique long advocated as a foundation of profitability analysis: decomposing rate of return on assets into asset turnover and profit margin. The results demonstrate, however, that it is the change in the components of profitability, rather than the current mix, that is informative about future changes in profitability, and that analysts and investors should focus on changes in asset turnover to improve forecasts of future profitability.

The results of this study provide specific guidance on how asset turnovers and profit margins can be used in forecasting future profitability. The results also provide a benchmark against which to assess the forecasting contribution of additional turnover and margin ratios.

Future research could test for other partitioning variables that would increase the information content of the change in asset turnover. In our attempt to provide guidance for a large set of firms on a general basis, we did not perform individual time series analyses within firms. Future research could test for the usefulness of the change in asset turnover by using a firm by firm time-series methodology. Future research could also attempt to identify specific firm characteristics that might make the change in asset turnover a more or less

reliable signal of future profitability. While our results have implications for cross-sectional analyses, future research could provide results both within firms and for firms with specific characteristics.

Finally, the results suggest an interesting area for future research in financial statement analysis and earnings management. Future research could test for a relation between the change in asset turnover and measures of aggressive accounting through earnings management, perhaps by examining changes in accounting for specific line items on the income statement. Perhaps the change in asset turnover could be used as a signal of earnings management.

Acknowledgments

Thanks to Bill Baber, Chris Jones, Jim Largay, Charles Lee, Jim Ohlson, Stephen Penman, Srini Sankaraguruswamy, Richard Sweeney, and seminar participants at Georgetown University, The George Washington University, Lehigh University, Rutgers University, Camden, and the University of California at Berkeley for comments on a previous version of this paper.

Notes

1. Stickney and Brown (1999) identify as the first learning objective in a chapter titled "Introduction to Profitability and Risk" to "analyze and interpret changes in the operating profitability of a firm using the rate of return on assets and its components: profit margin and asset turnover." Bernstein and Wild (1998) state "We [disaggregate return on assets into asset turnover and profit margin] because these component ratios are useful in our analysis of company performance." The technique is sometimes referred to as "DuPont Analysis," owing to its origin as a mangement tool in the E.I DuPont de Nemours Company in the early twentieth century.
2. We do not wish to discount the descriptive power of the disaggregation for understanding a firm's strategy, or its usefulness as a management tool. For a discussion along these lines, see Selling and Stickney (1989).
3. We also ran the analyses controlling for sales growth. The conclusions of the paper are not affected by the inclusion of prior sales growth as an explanatory variable.
4. Sloan (1996) shows that firms with higher proportions of accruals in current earnings are more likely to report decreases in operating profitability the following year. Based on evidence in Fairfield, Whisenant and Yohn (2001), demonstrating that accruals provide no incremental information over growth in explaining future profitability, we do not present results incorporating accruals as an explanatory variable. Sensitivity tests confirmed that the results reported in this paper are robust to the inclusion of accruals into the analysis.
5. We define operating income by starting with sales and subtracting specific expenses rather than starting with net income and adding unusual items in an attempt to better control for nonrecurring and unusual items. The results are the same if we calculate operating income as income before interest and nonrecurring items.
6. The data is taken from the Compustat data base and special items are those identified by Compustat. As discussed in Givoly and Hayn (1993), although Compustat does identify most of the unusual items shown as line items on the income statement, it does not identify most unusual items reported in footnote disclosures.
7. Approximately five percent of firms in each year have negative operating profit margins.
8. The results are unaffected by the disaggregation of the change in RNOA. We also tested individual models estimated for firms sorted into deciles by the rank of RNOA. The in-sample results suggested that the level of asset turnover and profit margin were informative for low profitability firms; however, these results were not robust in out-of-sample tests.
9. We also performed nonparametric tests in which we examined the ability of the change in asset turnover to predict the sign of the change in RNOA one year ahead. We first sorted the firms into deciles by current RNOA and calculated a chi-square statistic on whether firms in the lowest third with respect to the change in asset

turnover within each current RNOA decile were more likely to have reported a decrease in RNOA one year ahead. The statistic was significant in 9 of the RNOA deciles. We also performed the analysis by the current change in RNOA deciles and the chi-square was significant in 9 of the deciles. Finally, we performed the analysis by current growth deciles, and the chi-square statistic was significant in 6 of the deciles.

10. We also examined whether the change in specific turnover ratios (the receivables, inventory and property, plant and equipment turnovers) commonly cited in textbooks provide incremental information over the change in total asset turnover for forecasting the change in profitability one year ahead. The coefficients on the change in the inventory and receivables turnovers are insignificant while the coefficient on the property, plant and equipment turnover ratio is positive and significant.
11. We also ran a regression with growth in net operating assets one year ahead as the dependent variable. We found that the change in asset turnover provides incremental information for predicting growth one year ahead.

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