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The Asymmetric Relation Between Changes in Operational Efficiency and Stock Returns

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조 은 선

ABSTRACT

The Asymmetric Relation Between Changes in Operational Efficiency and Stock Returns

Eunsun Cho

College of Business Administration

The Graduate School

Seoul National University

According to prior literatures, there exists a positive relation between current stock returns and changes in operational efficiency. It indicates that equity investors reward an increase in a firm's operational efficiency and penalize a decrease in the efficiency. However, I find that the positive relation between stock returns and efficiency changes diminishes when sales decrease. This is because in sales-declining periods, equity investors cannot discern whether the reason for a decrease (an increase) in efficiency is inefficient (efficient) management or managers' optimistic (pessimistic) expectations about future performance. I also find that the positive relation between stock returns and efficiency changes is weakened in sales-decreasing periods, only when the efficiency changes are driven by managers' costs adjustment decisions. Moreover, I find that the positive

relation is more weakened in sales-decreasing periods in firms with lower information asymmetry. This study contributes to accounting literatures in that it suggests the direction of sales changes influences not only managers' but also equity investors' behavior.

Keywords : operational efficiency, stock returns, asymmetric cost behavior, cost stickiness, direction of sales changes, information asymmetry

Student Number : 2015-20674

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1. INTRODUCTION

A downturn in sales is a unique situation in management. Managers' decisions to maximize firm value in sales-declining periods are significantly different from those of sales-increasing periods. Asymmetric cost behavior is one example that supports the statement. According to cost stickiness literatures, when sales increase, managers proportionately increase the resources to accommodate the increased demand. However when sales decrease, managers are reluctant to cut the committed resources, because if they do, they have to restore the resources if sales increase in the near future, and it occurs high adjustment costs (Anderson, Banker, and Janakiraman, 2003). The sticky cost behavior is more severe when managers have optimistic expectations that the current sales reduction will not last long.

The sticky cost behavior often results in an increase in SG&A ratio (=SG&A costs divided by sales) in sales-declining periods, because the numerator (=SG&A costs) remains the same while the denominator (=sales) decreases. Therefore, a high SG&A ratio which has been criticized as a bad signal for inefficient management is rather a good signal for managers' optimistic expectations for future performance in sales-declining periods (Anderson, Banker, Huang, and Janakiraman, 2007). My research question is whether equity investors appreciate this kind of unique consequences of managers' rational decisions in sales-declining periods.

Equity investors reward an increase in a firm's operational efficiency and penalize a decrease in the efficiency. Operational efficiency is defined as a firm's ability to generate outputs (=sales) given inputs

(=PP&E, COGS, and SG&A costs). Using the widely known operational efficiency measure derived by DEA analysis, Baik, Chae, Choi, and Farber (2013) find a positive relation between changes in efficiency and current stock returns. Their results suggest that equity investors incorporate the value-relevant information in operational efficiency changes. However, I conjecture that the positive relation between efficiency changes and stock returns is weakened when sales decrease, if equity investors comprehend that the implications of efficiency changes are different between sales-increasing and decreasing periods.

This conjecture is motivated by Anderson et al. (2007) identifying the implications of SG&A ratio changes in sales-declining periods. They suggest that a high SG&A ratio is a bad signal for inefficient management in sales-increasing periods, while it is a good signal for managers' optimistic expectations for future performance in sales-decreasing periods. Specifically, they find that an increase in SG&A ratio is negatively associated with future earnings in the uptrend of sales, but positively associated in the downtrend of sales. Considering that the SG&A ratio (=input/output) and the operational efficiency (=output/input) are inversely related, their findings can be restated as follows: a decrease in operational efficiency in sales-declining periods is a good signal for future performance.

In this study, I examine whether equity investors comprehend the different implications of operational efficiency changes in sales-increasing and decreasing periods by examining the relation between current stock returns and efficiency changes in the two periods. In sales-increasing periods, changes in efficiency imply the literal sense of the words. Therefore, equity investors positively respond to the efficiency changes. However, in sales-declining periods, a decrease in efficiency implies either deteriorated

efficiency or managers' optimistic expectations about future performance. Similarly, an increase in efficiency in sales-declining periods reflects either improved efficiency or managers' pessimistic expectations about future demand. Therefore, the value-relevance of efficiency changes diminishes when sales decrease. Accordingly, I expect an asymmetric relation between stock returns and changes in operational efficiency: the positive relation between stock returns and efficiency changes is weakened in sales-declining periods.

To test this expectation, I firstly examine a positive relation between operational efficiency changes and current stock returns following Baik et al. (2013). Operational efficiency refers to the ability of a firm to generate outputs given inputs. To estimate operational efficiency, I employ several widely known efficiency measures: simple financial statement ratios such as asset turnover and the measure derived by DEA analysis. I put more emphasis on the DEA-based efficiency measure because many studies (Demerjian et al. 2012, and Baik et al. 2013) have verified the superiority of the measure relative to simple financial ratios. The positive relation between operational efficiency changes and stock returns suggests that equity investors apprehend the value-relevant information in operational efficiency changes.

Next, I test the main hypothesis: the positive relation between operational efficiency changes and current stock returns is weakened when sales decrease. This is because equity investors understand to some extent that a decrease (an increase) in operational efficiency in sales-decreasing periods reflects managers' optimistic (pessimistic) expectations about future performance, and hence they do not penalize (reward) the lowered (increased) operational efficiency. Consistent to the expectation, I find that

the relation between changes in operational efficiency and stock returns is positive in sales-increasing periods, but it is close to zero in sales-decreasing periods. The result indicates that the value-relevance of operational efficiency changes diminishes when sales decrease.

For additional analyses, I divide efficiency changes into two types: changes driven by abnormal sales changes and those driven by factors other than abnormal sales, for instance, managers' costs adjustment decisions. The positive relation between stock returns and efficiency changes is weakened in sales-declining periods, only when the efficiency changes are driven by factors other than abnormal sales changes. Also, I suggest that the positive relation is more weakened in sales-declining periods in firms with lower information asymmetry. I find that equity investors even negatively respond to efficiency changes in sales-declining periods when the firms are in the lowest quartile of information asymmetry.

This study contributes to accounting literatures in several ways. First, it suggests that the direction of sales changes influences not only managers' but also equity investors' decision-makings. There has been numerous studies on how the direction of sales changes influences managers' behavior. However, there has been little studies on how it influences equity investors' behavior. In this study, I suggest that the stock return responses to operational efficiency changes are asymmetric between the uptrend and the downtrend of sales. Second, it identifies that equity investors comprehend the rationale behind cost stickiness to some extent. Lastly, it associates one of the important topics in managerial accounting, cost stickiness, to an important variable in financial accounting, stock return responses.

The construction of this paper is as follows. In section 2, I review

the related prior literatures, and I develop the hypotheses in section 3. Section 4 provides the research design, and section 5 reports the empirical results. Lastly in section 6, I provide the conclusions.

2. LITERATURE REVIEW

2.1. Operational Efficiency Using DEA Analysis

Traditionally, researchers have used simple financial statement ratios such as return on net operating assets, profit margin, and asset turnover as the proxy of firms' operational efficiency. Recently, the efficiency measure derived by frontier analysis has been more widely used (Charnes, Cooper, and Rhodes 1978; Fairfield and Yohn 2001; Greene and Segal 2004). Data Envelope Analysis (DEA), a representative frontier analysis, is a nonparametric method to measure the relative efficiency of decision-making units (DMUs) within each industry. The researchers create an efficient frontier which maximizes each firm's ratio of outputs to inputs in an industry. DMUs located at the frontier (the most efficient firms) receive a value of one, and those located below the frontier (inefficient firms) receive lower scores. Frontier-based efficiency measures have advantages over simple financial ratios in that they use multiple inputs and outputs and allow for differential weighting among inputs. Hence, DEA provides more precise and conceptually appealing measures of firms' operational efficiency than the traditional efficiency measures.

Some studies in managerial accounting have used the DEA efficiency score to measure managerial ability. Since firms' efficiency is

affected by both firm-specific and manager-specific factors, the residual of the efficiency measure after removing a number of firm-specific characteristics is used as a proxy for managerial ability. Demerjian, Lev, and McVay (2012) identify the feasibility of the measure as a proxy for managerial ability through several validity tests.

2.2. Efficiency and Stock Returns

Several studies have documented the value-relevance of firms' operational efficiency by examining the relation between frontier-based operational efficiency scores and profitability. Greene and Segal (2004) find that there exists a negative relation between cost inefficiency and profitability such as ROA and ROE in the U.S. life insurance industry. Baik, Chae, Choi, and Farber (2013) also identify a positive relation between changes in operational efficiency and changes in current and future profitability.

Since profitability is positively associated with firm valuation, another set of studies suggest a positive relation between frontier-based efficiency scores and stock returns. Alam and Sickles (1998) show that the technical efficiency innovations in a quarter is positively related to stock returns in the following two months in the sample of the U.S. airline industry. Cummins and Xie (2008) find that M&As enhance both revenue efficiency of acquiring firms and cost efficiency of target firms in the U.S. property-liability insurance industry, and the efficiency enhancement is positively associated with stock market reactions to M&As. Furthermore, Baik et al. (2013) identify a positive relation between changes in operational efficiency and current abnormal returns, which suggests that efficiency changes convey value-relevant information to the market participants.

This study is different from Baik et al. (2013)' s study because I adopt the direction of sales changes as a main factor influencing the degree of relation between operational efficiency changes and stock returns. I conjecture the relation is positive as Baik et al. (2013)' s findings when sales increase, but the relation is weakened when sales decrease. Additionally, though Baik et al. (2013) employ Malmquist index to measure the changes in efficiency, I employ the changes in efficiency between one-year periods because of calculation difficulty. Also for simplicity, I compute the abnormal return as the return minus the industry average return, while they compute it as the return minus the benchmark portfolio return.

2.3. Asymmetric Cost Behavior and Stock Returns

Asymmetric cost behavior has been actively investigated in both managerial and financial accounting studies. Asymmetric cost behavior indicates that SG&A costs increase more when sales increase than they decrease when sales decrease by an equivalent amount (Anderson, Banker, and Janakiraman, 2003). This sticky cost behavior occurs because managers deliberately adjust the committed resources considering substantial adjustment costs and their expectations about future demand. To be specific, managers are reluctant to reduce the committed resources when sales decrease, because the demand reduction can be reversed in the future, and if so, substantial adjustment costs would occur to restore the resources.

Anderson, Banker, Huang, and Janakiraman (2007) show that a high SG&A ratio, which has been recognized as a bad signal for inefficient management, is actually a good signal for future earnings when sales decrease. A high SG&A ratio when sales decrease signals managers' optimistic expectations about future performance and their decisions to

avoid adjustment costs in the future. They support this hypothesis by showing a positive relation between one-year-ahead earnings changes and SG&A ratio changes when sales decrease, and a negative relation when sales increase. In other words, an increase in SG&A ratio when sales decrease is associated with an increase in future earnings, while an increase in the ratio when sales increase is associated with a decrease in future earnings. Their results suggest that the consequences of efficient management differ between sales-increasing and decreasing periods.

Anderson et al. (2007) also examine whether the market participants comprehend the implications of sticky cost behavior. They document that the market does not incorporate information in SG&A ratio changes so that positive abnormal returns can be earned on portfolios with long on firms with high increases in the SG&A ratio and short on firms with low increases in the ratio in sales-declining periods. Contrary to their findings, I suggest that the market comprehends the implications of higher SG&A ratios or lower efficiency in sales-declining periods by using extended sample periods (from 1981 to 2013) which include more recent periods than their sample periods (from 1983 to 2002).

3. HYPOTHESES DEVELOPMENT

I firstly reconfirm Baik et al. (2013)' s finding that there exists a positive relation between current abnormal returns and changes in operational efficiency, then I examine whether the relation diminishes when sales decrease. The positive relation suggested by Baik et al. (2013)

indicates that the market participants appreciate the value-relevant information in efficiency changes, so they reward an increase in efficiency and penalize a decrease in efficiency. However, I conjecture that the value-relevance of changes in operational efficiency declines in sales-decreasing periods. Therefore, I examine the conjecture as my main hypothesis.

According to Anderson et al. (2007), an increase in SG&A ratio in sales-declining periods is a good signal for future performance reflecting managers' optimistic expectations about future profitability. Their finding can be rephrased as follows: a decrease in efficiency in sales-declining periods is a positive signal, because SG&A ratio and operational efficiency are inversely related. Similarly, an increase in efficiency in sales-declining periods is a bad signal implying that managers have pessimistic expectations about future profitability so that they cut operational inputs decisively resulting in an increased efficiency.

Since future profitability is positively associated with firm valuation (Ohlson, 1995), I conjecture the stock return responses to efficiency changes differ between the uptrend and the downtrend of sales. If equity investors comprehend the implications of efficiency changes in sales-declining periods, they will not reward an increase in efficiency nor penalize a decrease in efficiency, because they cannot discern whether the changes are due to changes in managerial ability to control efficiency or managers' deliberate resource adjustment decisions considering future expectations. Therefore, the positive relation will be weakened when sales decrease.

Hypothesis 1. The positive relation between changes in operational efficiency and current stock returns is weakened in sales-declining periods.

Next, I examine whether equity investors respond differently to the two types of efficiency changes: efficiency changes due to abnormal sales changes, and those due to factors other than abnormal sales, such as managers' costs adjustment decisions. The implication of abnormal sales changes is straightforward, while the implication of resource changes is ambiguous. Equity investors dislike a decrease in abnormal sales and favor an increase in abnormal sales. I therefore expect equity investors positively respond to efficiency changes driven by abnormal sales changes in any situation. On the other hand, they cannot discern whether an efficiency change derived from managers' resource adjustment decisions is a good signal or a bad signal. Therefore, I conjecture the positive relation between efficiency changes and stock returns diminishes in sales-declining periods, only when the efficiency changes are derived from mangers' costs adjustment decisions.

Hypothesis 2. The positive relation between changes in operational efficiency and current stock returns is weakened in sales-declining periods, only when the efficiency changes are driven by managers' resource adjustment decisions.

Lastly, I test whether the positive relation between stock returns and efficiency changes is more weakened in sales-decreasing periods in firms with lower information asymmetry. When a firm's information asymmetry is relatively low, equity investors better discern whether the reason for a decrease in efficiency is inefficient management or managers' optimistic expectations, and vice versa. According to Anderson et al. (2007)' s finding that an increase in SG&A ratio (=a decrease in operational

efficiency) in sales-decreasing periods is associated with higher future earnings, the latter reason is more likely. I therefore expect that equity investors in firms with low information asymmetry respond even negatively to efficiency changes in sales-declining periods. In other words, they reward a decrease in efficiency and penalize an increase in efficiency, because they expect that a decrease (an increase) in efficiency reflects managers' optimistic (pessimistic) expectations about future performance.

I use two approaches to test the hypothesis. I firstly divide the sample into quartiles based on the level of information asymmetry, then examine whether the relation between efficiency changes and stock returns in sales-declining periods is smaller in the lowest quartile than in the highest quartile. The proxies for information asymmetry are capital expenditures, PP&E, and firm size.

Another approach is that I divide the sample period into pre-2007 and post-2007. I expect the information asymmetry has declined since 2007 for two reasons. First, due to the global financial crisis in 2007 and 2008, financial regulations have been enhanced and accounting information transparency has improved. Second, asymmetric cost behavior has been actively investigated since the mid-2000s, enabling equity investors better comprehend the concept. Moreover, it is identified by Anderson et al. (2007) that high SG&A ratios in sales-declining periods are associated with high future earnings according to sticky cost behavior. Their findings are expected to have reduced the information asymmetry between equity investors and firms.

Hypothesis 3a. The relation between changes in operational efficiency and current returns in sales-declining periods is smaller in firms with lower information asymmetry.

Hypothesis 3b. The relation between changes in operational efficiency and current returns in sales-declining periods is smaller after 2007 than before 2007.

4. RESEARCH DESIGN

4.1. DEA-based Efficiency Measure

Data Envelope Analysis (DEA) is a nonparametric method to estimate the relative efficiency of decision-making units (DMUs). Each DMU converts inputs to outputs, and efficiency is defined as the ratio of outputs over inputs. I use sales revenue as the sole output following prior studies. The frequently used inputs in calculating firms' operational efficiency are SG&A costs, costs of inventory, net PP&E, net operating leases, net R&D, purchased goodwill, and other intangible assets (Demerjian et al. 2012). I adopt three inputs which are key determinants of sales revenue following Baik et al. (2013): net PP&E, COGS, and SG&A costs.

Next, I assign a weight on each output and input following the DEA optimization procedure. First, I sort DMUs (firms) into groups (industries) within which the relative efficiency is estimated. The functions of outputs and inputs are similar within each industry, so the efficiency is comparable

between firms. Second, I maximize the ratio of outputs over inputs for each DMU by varying the weights of inputs and outputs. Third, the derived optimal weights are multiplied by the corresponding input and output quantities. The summation of all inputs and outputs generates an efficiency score for each DMU. Lastly, I create an efficient frontier within each industry, which consists of firms with the highest efficiency score within the industry. All efficiency scores are scaled by the highest score within the industry. As a result, firms located on the frontier receive a score of one, and firms below the frontier are assigned lower scores. This procedure yields the relative efficiency score of a firm within its industry.

DEA-based efficiency measures have significant advantages over traditional efficiency measures. First, DEA provides an ordinal ranking of efficiency scores within the industry. Second, DEA does not require weights on variables to be explicitly set. Third, DEA allows for differential weighting among variables. These advantages make DEA-based measures to be more precise and comprehensive than simple financial ratios.

4.2. Regression Models

To test the main hypothesis, I firstly replicate Baik et al. (2013) by regressing current abnormal returns on the efficiency changes as shown in equation (1). The dependent variable $\mathrm{INDADJ\_RET_{it}}$ is the industry-adjusted return defined as the 12-month buy-and-hold return minus the industry average return. The independent variable $\Delta\mathrm{EFF_{it}}$ is the change in operational efficiency defined as $\mathrm{EFF_{it} - EFF_{it-1}}$ where $\mathrm{EFF_{it}}$ is the firm i’s operational efficiency score in year t derived from DEA analysis. To the extent that equity investors reward an increase in efficiency and penalize a decrease in efficiency, I expect a positive and significant coefficient on

ΔEFF_{it}.

The control variables are also defined following Baik et al. (2013)' s regression models. $EARN_{it}$ is earnings per share deflated by lagged stock price, and $\Delta EARN_{it}$ is changes in EPS also divided by lagged stock price. Return on net operating assets ($RNOA_{it}$) is operating income deflated by lagged net operating assets excluding observations with negative net operating assets. Change in current RNOA ($\Delta RNOA_{it}$) is $RNOA_{it} - RNOA_{it-1}$. I decompose $\Delta RNOA_{it}$ into profit margin (PM_{it}) and asset turnover (ATO_{it}) following Fairfield and Yohn (2001). Changes in current profit margin (ΔPM_{it}) and asset turnover (ΔATO_{it}) is ($PM_{it} - PM_{it-1}$) and ($ATO_{it} - ATO_{it-1}$), respectively.

Additionally, I include the six fundamental signals that are related to future earnings changes following Abarbanell and Bushee (1997), because those factors are also related to current returns. Inventory (INV) is annual percentage change in inventory minus annual percentage change in sales. Accounts receivable (AR) refers to annual percentage change in accounts receivable minus annual percentage change in sales. Capital expenditures (CAPEX) is defined as annual percentage change in industry average capital expenditures minus annual percentage change in firm capital expenditures. Gross margin (GMARGIN) is annual percentage change in sales minus annual percentage change in gross margin. Selling and administrative expenses (SGA) refers to annual percentage change in SG&A costs minus annual percentage change in sales, and labor force (LABOR) is calculated as annual percentage change in the ratio of sales over the number of employees. Lastly, I include industry and year indicators to control for any industry or year fixed effect.

$$\begin{aligned}\text{INDADJ\_RET}_{it} = {} & \alpha_1 + \alpha_2 \Delta\text{EFF}_{it} + \alpha_3 \text{EARN}_{it} + \alpha_4 \Delta\text{EARN}_{it} + \alpha_5 \text{RNOA}_{it} \\ & + \alpha_6 \Delta\text{RNOA}_{it} + \alpha_7 \text{PM}_{it} + \alpha_8 \Delta\text{PM}_{it} + \alpha_9 \text{ATO}_{it} + \alpha_{10} \Delta\text{ATO}_{it} \\ & + \sum_{j=1}^{6} \text{Fundamental signals}_{jit} + \text{industry indicators} \\ & + \text{year indicators} + \varepsilon_{it} \quad \cdots (1)\end{aligned}$$

⇒ Expectation: $\alpha_2 > 0$

Next, I investigate whether the positive relation between efficiency changes and current return is weakened during sales-decreasing periods (hypothesis 1) by estimating equation (2). I include a dummy variable (SD_{it}) which equals 1 if sales decrease and 0 otherwise, and its interaction with efficiency changes. All other variables are as previously defined. I expect a positive coefficient on ΔEFF_{it} and a negative coefficient on $\text{SD}_{it} * \Delta\text{EFF}_{it}$ to support the hypothesis 1. The expected result indicates that the value-relevance of operational efficiency changes diminishes during sales-declining periods.

$$\begin{aligned}\text{INDADJ\_RET}_{it} = {} & \beta_1 + \beta_2 \Delta\text{EFF}_{it} + \beta_3 \text{SD}_{it} * \Delta\text{EFF}_{it} + \beta_4 \text{SD}_{it} + \beta_5 \text{EARN}_{it} \\ & + \beta_6 \Delta\text{EARN}_{it} + \beta_7 \text{RNOA}_{it} + \beta_8 \Delta\text{RNOA}_{it} + \beta_9 \text{PM}_{it} + \beta_{10} \Delta\text{PM}_{it} \\ & + \beta_{11} \text{ATO}_{it} + \beta_{12} \Delta\text{ATO}_{it} + \sum_{j=1}^{6} \text{Fundamental signals}_{jit} \\ & + \text{industry indicators} + \text{year indicators} + \varepsilon_{it} \quad \cdots (2)\end{aligned}$$

⇒ Expectation: $\beta_2 > 0$, $\beta_3 < 0$

To test the hypothesis 2, I employ a two-stage approach. In the first stage, I divide changes in operational efficiency into two types: those derived from abnormal sales changes and those derived from factors other than sales. Specifically, I regress changes in efficiency (ΔEFF_{it}) on abnormal sales changes (ABSALE_{it}), and estimate the firm-specific coefficients on

$ABSALE_{it}$ and the residuals.[①] Then, I calculate the estimated changes in efficiency with the estimated coefficients on $ABSALE_{it}$. The estimated changes in efficiency (ΔEFF_HAT_{it}) is the efficiency changes driven by abnormal sales changes, whereas the residual of the regression (ΔEFF_RED_{it}) is the efficiency changes driven by other factors such as managers' costs adjustment decisions.

$$\Delta EFF_{it} = \gamma_1 + \gamma_2 ABSALE_{it} + \varepsilon_{it}$$

$$\Rightarrow \Delta EFF\_HAT_{it} = \hat{\gamma}_{1i} + \hat{\gamma}_{2i} ABSALE_{it} \text{ and } \Delta EFF\_RED_{it} = \hat{\varepsilon}_{it}$$

In the second stage, I regress industry-adjusted returns on the estimated efficiency changes and the residual efficiency changes (equation 3). I expect positive coefficients on ΔEFF_HAT_{it} and ΔEFF_RED_{it}. I expect an insignificant coefficient on $SD_{it} * \Delta EFF\_HAT_{it}$, because equity investors reward an increase in efficiency due to an abnormal sales increase and penalize a decrease in efficiency due to an abnormal sales decrease in any situation. However, I expect a negative coefficient on $SD_{it} * \Delta EFF\_RED_{it}$, because equity investors do not penalize a decrease in efficiency due to managers' decisions to retain the committed resources even if sales decrease, because those decisions reflect managers' confidence about future performance.

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① Abnormal sales changes are defined as the actual changes in sales minus the expected changes in sales. The expected changes in sales are estimated through a rolling estimation for five consecutive years of an autoregression model $\Delta \ln Sales_{it} = \rho_{1i} + \rho_{2i} \Delta \ln Sales_{it-1} + \varepsilon_{it}$ (Banker, Byzalov, and Plehn-Dujowich, 2014).

$$\begin{aligned}INDADJ\_RET_{it} = {} & \beta_1 + \beta_2 \Delta EFF\_HAT_{it} + \beta_3 \Delta EFF\_RED_{it} + \beta_4 SD_{it} * \Delta EFF\_HAT_{it} \\ & + \beta_5 SD_{it} * \Delta EFF\_RED_{it} + \beta_6 SD_{it} + \beta_7 EARN_{it} + \beta_8 \Delta EARN_{it} \\ & + \beta_9 RNOA_{it} + \beta_{10} \Delta RNOA_{it} + \beta_{11} PM_{it} + \beta_{12} \Delta PM_{it} + \beta_{13} ATO_{it} \\ & + \beta_{14} \Delta ATO_{it} + \sum_{j=1}^{6} Fundamental\ signals_{jit} \\ & + industry\ indicators + year\ indicators + \varepsilon_{it} \quad \cdots (3)\end{aligned}$$

⇒ Expectation: $\beta_2 > 0$, $\beta_3 > 0$, $\beta_5 < 0$

To test the hypothesis 3a, I divide the sample into quartiles on the basis of the level of information asymmetry, then conduct the same regression in the equation (2) in each group. I employ the level of capital expenditures, property, plant, and equipment, and firm size as proxies for information asymmetry following prior studies. Information asymmetry is greater for firms with more capital expenditures, lower PP&E, and smaller firm size. (Fahlenbrach and Stulz, 2009; Aboody and Lev, 2000). I expect the coefficient on efficiency changes in sales-decreasing periods is smaller in the lowest information asymmetry group (Quartile1) than in the highest group (Quartile4). Similarly, I divide the sample at the year 2007 to test the hypothesis 3b, and expect the coefficient on efficiency changes in sales-decreasing periods is smaller post-2007 than pre-2007.

$$\begin{aligned}INDADJ\_RET_{it} = {} & \beta_1 + \beta_2 \Delta EFF_{it} + \beta_3 SD_{it} * \Delta EFF_{it} + \beta_4 SD_{it} + \beta_5 EARN_{it} \\ & + \beta_6 \Delta EARN_{it} + \beta_7 RNOA_{it} + \beta_8 \Delta RNOA_{it} + \beta_9 PM_{it} + \beta_{10} \Delta PM_{it} \\ & + \beta_{11} ATO_{it} + \beta_{12} \Delta ATO_{it} + \sum_{j=1}^{6} Fundamental\ signals_{jit} \\ & + industry\ indicators + year\ indicators + \varepsilon_{it} \quad \cdots (2)\end{aligned}$$

⇒ Expectation: $(\beta_2 + \beta_3)_{Q1\ or\ post-2007} < (\beta_2 + \beta_3)_{Q4\ or\ pre-2007}$

4.3. Sample

My sample includes firm-year observations listed on COMPUSTAT for the years 1981 – 2013. Return is computed using data from CRSP for the same periods. I exclude firms in financial service and utility industries from the sample due to the unique characteristics of the industries. Then, I exclude observations with any missing input and output variables on COMPUSTAT. Next, I drop firm-years with less than 20 observations in each year-industry set to estimate the efficiency measure. I also exclude firm-years with missing any other control variables used in the regressions. Lastly, I winsorize variables at the bottom and top 1 percent of their distributions. The final sample includes 67,997 observations.

5. EMPIRICAL RESULTS

5.1. Descriptive Statistics

Table 1 shows descriptive statistics of the variables used in the equation 2. The mean (median) of efficiency scores is 0.8671 (0.9321), and the mean (median) of changes in efficiency scores is -0.0037 (0.0000), respectively. Additionally, one standard deviation from the mean of changes in efficiency equals to a change of 10.96% in efficiency. Therefore, there exists sufficient variation in efficiency scores in my sample. Table 1 also shows that the mean (median) of current returns is 0.1955 (0.0500), and the mean (median) of current industry-adjusted returns is 0.0022 (-0.0728).

Table 2 provides correlations between key variables. The *p*-values are in parentheses. Both efficiency and changes in efficiency are positively

correlated with raw and industry-adjusted current returns, supporting my expectation that equity investors favor high operational efficiency and dislike low efficiency. In addition, DEA-based efficiency measures are positively correlated with the commonly used efficiency measure, asset turnover, supporting the validity of my efficiency measures. The changes of the two efficiency measures are also positively correlated.

Before I test the main hypothesis, I assess whether there are sufficient observations of efficiency changes in both sales-increasing sample and sales-decreasing sample. Table 3 reports that among the total sample of 67,997 observations, sales-increasing sample includes 48,599 observations and sale-decreasing sample shows 19,397 observations, while no sales change sample has only 1 observation. In sales-increasing sample, firm-years with different directions of efficiency changes are evenly distributed. Among 48,599 sample, 18,778 experienced an increase in efficiency, 14,749 experienced no change in efficiency, and 15,072 experienced a decrease in efficiency. In sales-decreasing sample of 19,397 firm-years, 4,930 increased in efficiency, 4,628 did not change in efficiency, and 9,839 decreased in efficiency. Lastly, the mean of efficiency changes is 0.0092 in the sales-increasing sample and -0.0360 in the sales-decreasing sample. The results support that there are sufficient observations of various sales changes and efficiency changes.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Q1	Median	Q3	Max
inv	0.0128	0.5160	-1.8031	-0.1649	-0.0155	0.1405	2.7669
ar	0.0411	0.4847	-1.3456	-0.1463	-0.0046	0.1495	2.6600
capex	-0.4128	1.6102	-10.6273	-0.5339	-0.0223	0.3353	1.1137
gmargin	-0.0029	0.3242	-1.7040	-0.0594	0.0008	0.0657	1.5704
sga	-0.0098	0.2875	-1.4997	-0.0793	0.0030	0.0864	0.9527
labor	-0.0927	0.3199	-1.8629	-0.1595	-0.0493	0.0448	0.5861
eff	0.8671	0.1729	0.2303	0.7985	0.9321	1.0000	1.0000
△eff	-0.0037	0.1096	-0.4213	-0.0302	0.0000	0.0247	0.3992
ato	3.2107	3.3461	0.2587	1.4875	2.2895	3.5905	23.2303
pm	0.0133	0.2934	-2.0369	0.0122	0.0608	0.1135	0.3763
△ato	-0.1870	3.3774	-20.8567	-0.4784	-0.0056	0.3926	13.7617
△pm	0.0003	0.1632	-0.7198	-0.0279	0.0000	0.0230	0.9047
rnoa	0.1177	0.5728	-3.1721	0.0280	0.1394	0.2739	2.1382
△rnoa	0.0230	0.7758	-3.5437	-0.0949	-0.0001	0.0848	4.6720
earn	0.0038	0.1893	-1.0517	-0.0141	0.0434	0.0821	0.4000
△earn	0.0141	0.2169	-0.7571	-0.0345	0.0031	0.0359	1.1931
ret	0.1955	0.8521	-0.9910	-0.2353	0.0500	0.3940	26.1942
indadj_ret	0.0022	0.6036	-1.1996	-0.3470	-0.0728	0.2213	2.7724

Table 2. Pearson Correlations

	ret	indadj_ret	ato	△ato
eff	0.0427	0.0707	0.1127	0.0400
	(<.0001)	(<.0001)	(<.0001)	(<.0001)
△eff	0.1078	0.1346	0.0945	0.1316
	(<.0001)	(<.0001)	(<.0001)	(<.0001)

Table 3. Count of Observations

	△eff > 0	△eff = 0	△eff < 0	Total	Mean(△eff)
△S > 0	18778	14749	15072	48599	0.0092
△S = 0	0	0	1	1	-0.1783
△S < 0	4930	4628	9839	19397	-0.0360
Total	23708	19377	24912	67997	-0.0037

5.2. Efficiency Changes and Current Returns

The results of the first hypothesis are presented in table 4. Column 1 shows the results of regressions of industry-adjusted current stock returns on efficiency changes (equation 1). Column 2 presents the results of regressions including a sales decrease dummy and its interaction with efficiency changes (equation 2). In both columns, the coefficients on changes in efficiency are positive and significant (0.2302 and 0.2895, respectively). The coefficients are significant even after controlling for changes in traditional efficiency measures (△RNOA, △PM, and △ATO), suggesting that DEA-based efficiency measures provide incremental information over traditional efficiency measures. These results reconfirm Baik et al. (2013)' s findings that equity investors apprehend the value-relevant information in operational efficiency changes.

As my expectation, column 2 reports a positive coefficient on efficiency changes and a negative coefficient on efficiency changes interacted with a sales-decrease dummy. To be specific, the coefficient on efficiency changes is 0.2895 (β_2) in sales-increasing periods, while it is 0.0342 ($\beta_2 + \beta_3$) in sales-decreasing periods. The results support the hypothesis 1 that the positive relation between efficiency changes and current returns is weakened in sales-declining periods.

Table 4. Regressions of industry-adjusted current stock returns on efficiency changes

	Dependent variable = $\mathbf{indadj\_ret_t}$			
	(1) Estimate	*p*-value	(2) Estimate	*p*-value
intercept	0.0900	(0.1675)	0.1252*	(0.0969)
△eff	0.2302***	(<.0001)	0.2895***	(<.0001)
sd*△eff			-0.2553***	(<.0001)
sd			-0.0939***	(<.0001)
earn	0.1534***	(<.0001)	0.1102***	(<.0001)
△earn	0.4944***	(<.0001)	0.5130***	(<.0001)
rnoa	0.0731***	(<.0001)	0.0675***	(<.0001)
△rnoa	0.0117***	(0.0072)	0.0121***	(0.0051)
pm	-0.0177	(0.2358)	-0.0170	(0.2544)
ato	0.0025***	(0.0059)	0.0019**	(0.0315)
△pm	0.0620**	(0.0255)	0.0530*	(0.0582)
△ato	0.0038***	(<.0001)	0.0036***	(<.0001)
inv	-0.0142**	(0.0178)	-0.0135**	(0.0232)
ar	0.0220***	(0.0002)	0.0230***	(0.0001)
capex	-0.0031*	(0.0794)	-0.0010	(0.5692)
gmargin	-0.1185***	(<.0001)	-0.1161***	(<.0001)
sga	-0.1718***	(<.0001)	-0.1520***	(<.0001)
labor	0.0857***	(<.0001)	0.1053***	(<.0001)
R^2	0.0972		0.1011	
△eff + sd*△eff			0.0342	

5.3. Sales-driven vs. Costs-driven Efficiency Changes

Table 5 presents the results of the second hypothesis based on the regressions of industry-adjusted current stock returns on the estimated efficiency changes (ΔEFF_HAT) and the residual efficiency changes (ΔEFF_RED) (equation 3). The estimated efficiency changes based on abnormal sales changes are sales-driven efficiency changes, and the residual efficiency changes are costs-driven efficiency changes. In both column 1 and 2, the coefficients on ΔEFF_HAT and ΔEFF_RED are positive and significant as my expectation. The coefficients on ΔEFF_HAT are larger than those on ΔEFF_RED (0.5011>0.1397 in column 1, and 0.5115>0.2462 in column 2), meaning that equity investors respond more sensitively on sales-side efficiency changes than costs-side efficiency changes. I conjecture this is because sales-side efficiency changes appear more obviously in financial statements, whereas efficiency changes due to managers' costs adjustment decisions do not.

In column 2, the coefficient on $SD * \Delta EFF\_HAT$ is insignificant, meaning that equity investors respond consistently to sales-side efficiency changes regardless of the direction of sales changes. On the other hand, the coefficient on $SD * \Delta EFF\_RED$ is negative and significant (-0.3726) as my expectation. Moreover, the sum of coefficients on ΔEFF_RED and $SD * \Delta EFF\_RED$ is negative (-0.1264). This indicates that in sales-declining periods, equity investors reward a decrease in efficiency driven by managers' decisions to retain the level of costs, because those decisions reflect managers' confidence about future performance. Also, it means that equity investors penalize an increase in efficiency driven by managers' decisions to cut costs following a sales decrease, because those decisions reflect managers' pessimistic expectations about future performance.

Table 5. Regressions of industry-adjusted current stock returns on the estimated efficiency changes and the residual efficiency changes

	Dependent variable = $\mathbf{indadj\_ret_t}$			
	(1) Estimate	*p*-value	(2) Estimate	*p*-value
intercept	-0.0810	(0.2721)	-0.0365	(0.6173)
△eff_hat	0.5011***	(<.0001)	0.5115***	(<.0001)
△eff_red	0.1397***	(0.0007)	0.2462***	(<.0001)
sd*△eff_hat			-0.1307	(0.5496)
sd*△eff_red			-0.3726***	(<.0001)
sd			-0.0883***	(<.0001)
earn	0.2398***	(<.0001)	0.1882***	(<.0001)
△earn	0.4995***	(<.0001)	0.5237***	(<.0001)
rnoa	0.0669***	(<.0001)	0.0545***	(0.0003)
△rnoa	0.0933***	(<.0001)	0.0953***	(<.0001)
pm	-0.0238	(0.4368)	-0.0137	(0.651)
ato	0.0058***	(0.0003)	0.0055***	(0.0005)
△pm	-0.0989*	(0.0887)	-0.1048*	(0.0715)
△ato	0.0055*	(0.0529)	0.0046	(0.1052)
inv	-0.0448***	(0.0003)	-0.0423***	(0.0007)
ar	0.0443***	(<.0001)	0.0446***	(<.0001)
capex	-0.0105***	(0.0008)	-0.0082***	(0.008)
gmargin	-0.1167***	(<.0001)	-0.1147***	(<.0001)
sga	-0.1748***	(<.0001)	-0.1425***	(<.0001)
labor	0.0590***	(0.0018)	0.0845***	(<.0001)
R^2	0.1157		0.1203	
△eff_hat + sd*△eff_hat			0.5115	
△eff_red + sd*△eff_red			-0.1264	

These results support the hypothesis 2 that the positive relation between stock returns and efficiency changes diminishes in sales-declining periods, only when the efficiency changes are driven by managers' costs adjustment decisions.

5.4. Information Asymmetry

Table 6 shows the descriptive statistics of proxies for information asymmetry after winsorizing at the bottom and top 1%. ASYM_CAPEX is defined as capital expenditures scaled by total asset of the prior year. ASYM_PP&E is defined as property, plant, and equipment scaled by total asset of the prior year. Lastly, ASYM_SIZE indicates firm size and defined as total asset of the firm in the current year. Based on these statistics, I set the lowest quartile of ASYM_CAPEX and the highest quartiles of ASYM_PP&E and ASYM_SIZE as the lowest information asymmetry sample, and vice versa.

The results of regressions of industry-adjusted stock returns on efficiency changes are presented in table 7. For each panel, column 1 shows the regression results in the lowest information asymmetry quartile, and column 2 shows those in the highest information asymmetry quartile. The criteria for dividing quartiles is CAPEX in panel A, PP&E in panel B, and firm size in panel C. The number of observations is 16,999, 16,996, and 16,999 for each column of panel A, B, and C, respectively.

In the all columns in table 7, coefficients on changes in efficiency are positive and significant, while coefficients on changes in efficiency interacted with a sales decrease dummy are negative and significant, except in column 2 of panel C. The results identify the positive relation between efficiency changes and industry-adjusted returns in sales-increasing periods.

Table 6. Descriptive statistics of proxies for information asymmetry

Variable	Mean	Std. Dev.	Min	Q1	Median	Q3	Max
asym_capex	0.1077	0.2527	0.0003	0.0217	0.0471	0.0964	2.1045
asym_pp&e	0.4406	0.9821	0.0013	0.1142	0.2441	0.4409	8.5245
asym_size	1702.54	5728.06	3.19	37.75	142.90	678.71	43141.00

However, the interesting point is that the relation becomes negative in sales-decreasing periods in the low information asymmetry groups ($\beta_2 + \beta_3$=-0.0486, -0.0149, and -0.1993, respectively), while the relation is small but still positive in sales-declining periods in the high information asymmetry groups ($\beta_2 + \beta_3$=0.0867, 0.0040, and 0.2345, respectively).

These results are consistent to the hypothesis 3a that the relation between efficiency changes and stock returns is more weakened in sales-declining periods in firms with lower information asymmetry. It indicates that equity investors with low information asymmetry better comprehend the rationale behind a decrease (an increase) in efficiency in the downturn of sales, which are managers' optimistic (pessimistic) expectations about future performance, and hence rather penalize an increase in efficiency and reward a decrease in efficiency.

Table 7. Regressions of industry-adjusted current stock returns on efficiency changes

Panel A. CAPEX for information asymmetry

	(1) Low asymmetry (CAPEX Q1)		(2) High asymmetry (CAPEX Q4)	
	Estimate	*p*-value	Estimate	*p*-value
intercept	-0.0717**	(0.0102)	0.1137	(0.1669)
△eff	0.2610***	(<.0001)	0.3548***	(<.0001)
sd*△eff	-0.3096***	(0.0008)	-0.2681***	(0.0096)
sd	-0.0951***	(<.0001)	-0.0679***	(<.0001)
earn	0.0262	(0.4552)	0.3901***	(<.0001)
△earn	0.5469***	(<.0001)	0.3025***	(<.0001)
rnoa	0.0488***	(0.0004)	0.1016***	(<.0001)
△rnoa	0.0233***	(0.0005)	-0.0037	(0.5949)
pm	0.0113	(0.6434)	-0.0832***	(0.005)
ato	0.0042***	(0.0079)	-0.0033*	(0.0584)
△pm	-0.0269	(0.5655)	0.0967*	(0.0623)
△ato	0.0026*	(0.0586)	0.0049***	(0.0009)
inv	-0.0080	(0.4687)	-0.0193**	(0.0368)
ar	0.0249**	(0.0407)	0.0168*	(0.0666)
capex	0.0006	(0.8811)	-0.0024	(0.3466)
gmargin	-0.1147***	(<.0001)	-0.1061***	(<.0001)
sga	-0.1816***	(<.0001)	-0.1269***	(<.0001)
labor	0.0788***	(<.0001)	0.1385***	(<.0001)
R^2	0.1156		0.0908	
△eff + sd*△eff	-0.0486		0.0867	

Table 7. Panel B. PP&E for information asymmetry

	(1) Low asymmetry (PP&E Q4)		(2) High asymmetry (PP&E Q1)	
	Estimate	*p*-value	Estimate	*p*-value
intercept	0.1321	(0.1498)	-0.0099	(0.9171)
△eff	0.2908***	(<.0001)	0.3020***	(<.0001)
sd*△eff	-0.3057***	(0.0026)	-0.2980***	(0.0008)
sd	-0.0708***	(<.0001)	-0.1036***	(<.0001)
earn	0.1593***	(0.0005)	-0.0500	(0.2153)
△earn	0.4618***	(<.0001)	0.5997***	(<.0001)
rnoa	0.0894***	(<.0001)	0.0502***	(<.0001)
△rnoa	-0.0166**	(0.0434)	0.0181***	(0.0023)
pm	-0.0335	(0.2939)	0.0220	(0.339)
ato	-0.0033	(0.1272)	0.0047***	(0.0013)
△pm	0.0365	(0.499)	-0.0500	(0.2663)
△ato	0.0044***	(0.0032)	0.0028**	(0.0328)
inv	-0.0127	(0.1731)	0.0130	(0.2282)
ar	0.0058	(0.5154)	0.0357***	(0.0017)
capex	0.0007	(0.8219)	-0.0022	(0.5193)
gmargin	-0.0849***	(<.0001)	-0.1146***	(<.0001)
sga	-0.0967***	(<.0001)	-0.2401***	(<.0001)
labor	0.1293***	(<.0001)	0.0983***	(<.0001)
R^2	0.1156		0.1161	
△eff + sd*△eff	-0.0149		0.0040	

Table 7. Panel C. Firm size for information asymmetry

	(1) Low asymmetry (SIZE Q4)		(2) High asymmetry (SIZE Q1)	
	Estimate	*p*-value	Estimate	*p*-value
intercept	0.1556***	(<.0001)	-0.0985**	(0.0165)
△eff	0.1335*	(0.0667)	0.2345***	(<.0001)
sd*△eff	-0.3328**	(0.0254)	-0.0750	(0.3435)
sd	-0.0181**	(0.0462)	-0.1445***	(<.0001)
earn	-0.0434	(0.4345)	0.0975**	(0.0104)
△earn	0.5043***	(<.0001)	0.5393***	(<.0001)
rnoa	0.0557***	(0.0073)	0.0855***	(<.0001)
△rnoa	-0.0054	(0.5992)	0.0145**	(0.0307)
pm	0.0080	(0.8693)	-0.0382	(0.104)
ato	-0.0017	(0.3962)	0.0053***	(0.0089)
△pm	0.0868	(0.2426)	-0.1023**	(0.0201)
△ato	0.0031*	(0.0663)	0.0044**	(0.0119)
inv	-0.0289**	(0.0106)	0.0039	(0.7238)
ar	0.0072	(0.5028)	0.0279**	(0.0132)
capex	0.0168***	(<.0001)	-0.0059**	(0.0366)
gmargin	-0.0529***	(0.0086)	-0.1339***	(<.0001)
sga	-0.0011	(0.9646)	-0.2346***	(<.0001)
labor	0.0467***	(0.0062)	0.1016***	(<.0001)
R^2	0.0856		0.1291	
△eff + sd*△eff	-0.1993		0.2345	

Table 8 reports the results of regressions of industry-adjusted stock returns on efficiency changes in pre-2007 sample and post-2007 sample. Column 1 uses firm-year observations from 1981 to 2006, and the number of observations is 55,541. Column 2 uses observations between 2007 and 2013, and the number of observations is 12,456. The coefficients on efficiency changes are positive and significant, and the coefficients on efficiency changes interacted with a sales decrease dummy are negative and significant in both columns. Consistent to the hypothesis 3b, the coefficient on efficiency changes in sales-declining periods is small but still positive in pre-2007 sample ($\beta_2 + \beta_3$=0.0559), while it becomes negative in post-2007 sample ($\beta_2 + \beta_3$=-0.1722).

The results indicate that investors reward a decrease in efficiency and penalize an increase in efficiency in sales-declining periods after 2007. The reason for the results is that information asymmetry between firms and investors has diminished due to the adoption of regulations reinforcing accounting transparency after the global financial crisis in 2007 and 2008, and hence investors' ability to comprehend the rationale behind efficiency changes in sales-declining periods has improved.

Table 8. Regressions of industry-adjusted current stock returns on efficiency changes before and after 2007

	(1) Before 2007		(2) After 2007	
	Estimate	*p*-value	Estimate	*p*-value
intercept	0.1213	(0.1099)	0.0748	(0.271)
△eff	0.2921***	(<.0001)	0.2630***	(0.0005)
sd*△eff	-0.2362***	(<.0001)	-0.4352***	(0.0005)
sd	-0.0936***	(<.0001)	-0.0819***	(<.0001)
earn	0.1959***	(<.0001)	-0.1984***	(0.0002)
△earn	0.4588***	(<.0001)	0.6831***	(<.0001)
rnoa	0.0739***	(<.0001)	0.0435***	(0.0008)
△rnoa	0.0125***	(0.0078)	0.0105	(0.2977)
pm	-0.0411**	(0.016)	0.0817***	(0.0076)
ato	0.0033***	(0.0027)	-0.0028*	(0.0559)
△pm	0.0550*	(0.0801)	0.0551	(0.3587)
△ato	0.0040***	(<.0001)	0.0007	(0.6805)
inv	-0.0165**	(0.013)	-0.0028	(0.8276)
ar	0.0217***	(0.0009)	0.0274**	(0.041)
capex	-0.0031	(0.104)	0.0135***	(0.0014)
gmargin	-0.1237***	(<.0001)	-0.0933***	(<.0001)
sga	-0.1644***	(<.0001)	-0.0885***	(0.0064)
labor	0.1025***	(<.0001)	0.0870***	(0.0002)
R^2	0.1035		0.1111	
△eff + sd*△eff	0.0559		-0.1722	

5.5. Robustness Checks

To support the validity of the hypothesis 3, I suggest that a decrease in efficiency in sales-declining periods is associated with an increase in earnings in the next year. Table 9 column 1 presents the results of regressions of one-year-ahead changes in earnings on changes in operational efficiency. The coefficient on efficiency changes in sales-increasing periods is positive and significant (β_2=0.0196), and it indicates that an increase in efficiency in sales-increasing periods is associated with an increase in next-year earnings. On the other hand, the coefficient on efficiency changes in sales-decreasing periods is negative ($\beta_2 + \beta_3$=-0.0424), and it implies that a decrease in efficiency in sales-decreasing periods is associated with an increase in next-year earnings. The results support the conjecture that a decrease in efficiency in sales- declining periods reflects managers' optimistic expectations that the current reduction in sales will not continue in the next year.

Additionally, I examine whether successive sales decreases affect stock return responses to efficiency changes. Table 9 column 2 reports the results of regressions of industry-adjusted current returns on efficiency changes, including a dummy variable for successive sales decrease and its interaction with efficiency changes. SSD equals 1 if sales decrease for two consecutive years, and 0 otherwise. The coefficient on efficiency changes is positive (β_2=0.2908) and the coefficient on efficiency changes interacted with a sales decrease dummy is negative (β_3=-0.2523) consistent to the main hypothesis. However, the coefficient on efficiency changes interacted with a successive sales decrease dummy is insignificant. This implies that successive sales decreases do not affect equity investors' behavior, because equity investors do not regard managers' optimistic expectations

can be a reason for a decrease in efficiency when sales have declined for two successive years.

Table 9. Robustness checks: future earnings and successive sales decrease

	(1) Dep. = $\Delta EARN_{t+1}$		(2) Dep. = $indadj\_ret_t$	
	Estimate	*p*-value	Estimate	*p*-value
intercept	-0.0095	(0.5991)	0.1375*	(0.0759)
△eff	0.0196**	(0.0259)	0.2908***	(<.0001)
sd*△eff	-0.0621***	(0.0019)	-0.2523***	(<.0001)
ssd*△eff			-0.0357	(0.673)
sd	0.0007	(0.7469)	-0.1121***	(<.0001)
ssd			0.0464***	(<.0001)
earn	-0.5525***	(<.0001)	0.1181***	(<.0001)
△earn	-0.0626***	(<.0001)	0.5067***	(<.0001)
rnoa			0.0677***	(<.0001)
△rnoa			0.0119***	(0.0058)
pm	0.0346***	(<.0001)	-0.0150	(0.3153)
ato	0.0010***	(<.0001)	0.0020**	(0.0284)
△pm	-0.0335***	(0.0007)	0.0560**	(0.0452)
△ato	0.0010***	(<.0001)	0.0034***	(<.0001)
inv	-0.0094***	(<.0001)	-0.0135**	(0.0231)
ar	-0.0047**	(0.0144)	0.0227***	(0.0001)
capex	0.0028***	(<.0001)	-0.0010	(0.5726)
gmargin	-0.0112***	(0.0021)	-0.1156***	(<.0001)
sga	-0.0187***	(<.0001)	-0.1510***	(<.0001)
labor	-0.0003	(0.9381)	0.1048***	(<.0001)
R^2	0.2444		0.1015	
△eff + sd*△eff	-0.0424		0.0384	

For another robustness test, I test whether accounting losses influence the main results. According to earnings response coefficients literatures, the existence of losses reduces ERC because losses are not expected to perpetuate and hence less likely to affect the firm's future cash flows (Hayn, 1995). This finding shares similar logics with this paper in that a sales decrease or a loss reduces the positive relation between stock returns and efficiency changes or unexpected earnings, and in that a sales decrease or a loss is not expected to sustain in the long-run.

To test whether my hypothesis is still valid after controlling for losses, I include a dummy variable for losses and its interaction with efficiency changes in my regression model. I also include market to book ratio (MTB) and debt to equity ratio (DTE) which are commonly used control variables in ERC literatures. Consistent to the main hypothesis, table 10 column 1 shows a positive β_2 and a negative β_3. Moreover, it shows a negative and significant coefficient on efficiency changes interacted with a loss dummy, which means that the existence of losses also reduces the positive relation between efficiency changes and stock returns.

For another approach, I exclude observations experiencing losses from the sample resulting in 49,179 observations, and perform the same regression in hypothesis 1. Table 10 column 2 reports the consistent results with those of hypothesis 1. The overall results support that the positive relation between efficiency changes and stock returns diminishes in sales-declining periods even after considering accounting losses.

Table 10. Robustness checks: the existence of losses

	Dependent variable = $\mathbf{indadj\_ret_t}$			
	(1) Estimate	*p*-value	(2) Estimate	*p*-value
intercept	0.1680**	(0.0117)	0.0271	(0.6692)
△eff	0.3730***	(<.0001)	0.2070***	(<.0001)
sd*△eff	-0.1916***	(0.0002)	-0.2315***	(0.0031)
loss*△eff	-0.2403***	(<.0001)		
sd	-0.0741***	(<.0001)	-0.0736***	(<.0001)
loss	-0.0914***	(<.0001)		
earn	-0.0386	(0.1355)	2.0318***	(<.0001)
△earn	0.5319***	(<.0001)	0.2624***	(<.0001)
mtb	0.0198***	(<.0001)		
dte	-0.0246***	(<.0001)		
rnoa	0.0403***	(<.0001)	0.0989***	(<.0001)
△rnoa	0.0143***	(0.0007)	0.0073	(0.2415)
pm	0.0272*	(0.0741)	-0.0718	(0.1835)
ato	-0.0005	(0.5425)	-0.0054***	(0.0004)
△pm	0.0300	(0.2872)	0.4965***	(<.0001)
△ato	0.0039***	(<.0001)	0.0025**	(0.0214)
inv	-0.0131**	(0.0262)	-0.0113	(0.1305)
ar	0.0214***	(0.0003)	0.0078	(0.3033)
capex	-0.0005	(0.7556)	0.0097***	(<.0001)
gmargin	-0.1073***	(<.0001)	-0.1143***	(<.0001)
sga	-0.1462***	(<.0001)	-0.1290***	(<.0001)
labor	0.0993***	(<.0001)	0.0899***	(<.0001)
R^2	0.1186		0.1506	
△eff + sd*△eff	0.1814		-0.0245	

6. CONCLUSION

Overall, this paper identifies that the positive relation between current stock returns and changes in operational efficiency declines in sales-decreasing periods using a large sample of observations between 1981 and 2013. Usually, equity investors reward an increase in efficiency and penalize a decrease in efficiency. However, in sales-declining periods, managers often choose to retain the committed resources when they have optimistic expectations that the current sales reduction will not last in the future. This decisions lead to a decrease in operational efficiency, but it does not mean managers' inefficiency in managing resources, but rather means managers' confidence about future performance.

According to my empirical results, equity investors comprehend the rationale behind the changes in efficiency in sales-declining periods, and hence do not penalize a decrease in efficiency nor reward an increase in efficiency in those periods. This phenomenon is found only when the efficiency changes are driven by managers' costs adjustment decisions, not by abnormal sales changes. Moreover, when information asymmetry between firms and investors is low, equity investors better comprehend the rationale, and even reward a decrease in efficiency and penalize an increase in efficiency in sales-decreasing periods.

This paper contributes to accounting literatures in that it suggests the direction of sales changes affects not only managers' but also investors' behavior. Also, it identifies that equity investors comprehend the rationale behind sticky cost behavior to some extent. Lastly, it associates topics in managerial accounting and financial accounting. However, this

paper requires further improvements including the tests on whether analysts appreciate the value-relevant information in efficiency changes in sales-declining periods, or explanations on why stock return responses in small firms do not differ between sales-increasing and decreasing periods.

Last but not least, we need to distinguish the operational efficiency as a firm's ability and the operational efficiency scores. What I refer to a change in operational efficiency is a change in efficiency scores, not a change in the firm's ability. Specifically, when sales decrease but managers have confidence about future sales, they do not reduce the committed resources, and it results in a decreased efficiency score. However, the decreased efficiency score is a result of managers' efficient decision-makings aiming for firm value maximization. This paper suggests that the way to efficiently manage a firm is different between the uptrend and the downtrend of sales, and moreover, equity investors comprehend the unique consequences of efficient management in sales-declining periods.

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국문 초록

선행연구에 따르면, 주가수익률과 기업의 영업효율성 변화 사이에는 양의 상관관계가 존재한다. 다시 말해, 주식투자자들은 기업의 영업효율성이 증가하면 보상을 주고, 영업효율성이 감소하면 패널티를 준다. 그러나 본 연구는 매출이 감소할 때 영업효율성 변화와 주가수익률 사이의 양의 상관관계가 약해짐을 발견했다. 매출이 감소할 때 주식투자자들은 영업효율성 감소(증가)의 이유가 경영 효율성의 저하(개선) 때문인지, 아니면 미래 매출에 대한 경영자의 긍정적(부정적) 예상 때문인지 파악할 수 없다. 때문에 매출 감소 시기에는 주식투자자들이 영업효율성 변화에 반응하지 않는 것이다.

비대칭적 원가행태 연구에 따르면, 현재 매출이 감소했어도 경영자가 미래 매출에 대해 긍정적인 예상을 한다면 투입자원의 총량을 유지하는 경향이 있다고 한다. 이러한 행태는 영업효율성의 감소로 이어진다. 따라서 매출 감소 시기에 영업효율성의 감소는 기업 경영이 비효율적이 되었음을 의미하는 부정적 신호일 수도 있고, 경영자가 미래 성과를 긍정적으로 예상한다는 긍정적 신호일 수도 있다. 주식투자자들은 매출 감소 시기에 영업효율성 변화의 의미가 모호하다는 것을 인지하기 때문에 영업효율성 변화에 반응하지 않는다.

본 연구는 매출 감소 시기에 영업효율성 변화와 주가수익률 사이의 양의 관계가 0에 가까워짐을 발견했다. 또한, 영업효율성 변화가 원가행태의 변화에 의한 것일 때에만 양의 관계가 약해짐을 밝혔다. 그리고 주주와 기업 사이에 정보비대칭이 작은 기업일수록 양의 관계가 더 약해짐을 밝혔다. 이 발견은 주식투자자들이 비대칭적 원가행태의 의미를 인지하고 있다는 것을 나타내 준다.

주요어 : 영업효율성, 주가수익률, 비대칭적 원가행태, 매출 변화, 매출 감소, 정보비대칭

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