Management Forecasts of Costs: Do Managers Accurately Estimate Costs?

Kenji Yasukata*

Abstract

Virtually all firms listed on Japanese stock exchanges report point forecasts of sales and earnings in their annual press releases. The availability of management forecasts in Japan provides a unique research opportunity to investigate managers' understanding of the cost behavior of their company. Information regarding the forecasted costs is available by subtracting forecasted earnings from forecasted sales. Using recent "sticky cost" research methods, the forecasted rate of change in costs can be compared with the actual rate of change in costs. The major findings of this paper are that managers accurately predict the rate of increase in costs when sales are expected to increase; however, they tend to slightly overestimate the rate of decrease in costs when sales are expected to decrease.

Keywords: management forecasts, cost forecasts, cost behavior, cost stickiness, sticky costs

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Data Availability: All data used in this paper are obtained from public sources.

1. Introduction

The Timely Disclosure Rules enforced by Japanese stock exchanges strongly encourage managers of listed firms in Japan to provide point forecasts of sales and earnings. Under these rules, listed companies are expected to release forecasts for the next fiscal year at each annual fiscal-year earnings announcement date. Although releasing management forecasts is voluntary, the large majority of companies comply with this request. Some authors argue that forecast disclosure in Japan is "effectively mandated" (Kato et al. 2009). In fact, the sample used in this paper shows that over 99.9% of the listed companies, except for banks and companies in the security and insurance industry, released their management forecasts during the sample period from 2008 to 2010.

Management forecasts play an important role in conveying managers' information on their business outlook directly to investors. It is believed that the direct provision of management forecasts to investors will reduce the information asymmetry between managers and investors.[1] However, previous studies of management earnings forecasts have revealed that they tend to be overestimated, upward-biased, or optimistic; that is, forecasted earnings are greater than reported earnings (Rogers and Stocken 2005; Ota 2006; Kato et al. 2009). If management earnings forecasts are optimistic, they will mislead investors' decision making, even though providing management earnings forecasts will reduce the information asymmetry between managers and investors. The forecast error of earnings, that is, the difference between forecasted earnings and reported earnings, can be attributed to the forecast error of sales and/or the forecast error of costs. Thus, focusing on both forecast error of sales and forecast error of costs will provide deeper insights into the characteristics of management earnings forecasts because earnings are calculated through aggregation of sales and costs.

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* Faculty of Business Administration, Kinki University, Osaka, Japan.

[1] Source: Research Reports on Management Forecasts 2011 (available only in Japanese), Japan Security Research Institute, available at http://www.jsri.or.jp/.

The availability of management forecasts for earnings and sales for nearly all listed companies in Japan provides a unique research opportunity to investigate managers' estimation of the cost behavior of their company. In order to obtain cost forecast information, forecasted earnings are subtracted from forecasted sales. On the basis of forecasted costs and sales, the "managers' cost prediction model" can then be derived from the forecasted change in both costs and sales, and it can be inferred that managers forecast their company's costs with this model in mind. In addition, on the basis of the reported costs and sales, the "actual cost fluctuation model" can be derived from the actual change in costs and sales. The purpose of this paper is to investigate cost forecast error on the basis of a comparison between the perceived "managers' cost prediction model" and the "actual cost fluctuation model."

This paper incorporates "sticky cost" behavior in the managers' cost prediction model and actual cost fluctuation model. By focusing on the rate of change in costs in response to the change in sales, recent management accounting research on cost behavior has revealed that costs increase in response to an increase in sales; however, costs do not decline proportionately with a decrease in sales (Anderson et al. 2003; Weidenmier and Subramaniam 2003; Calleja et al. 2006; Anderson et al. 2007; Yasukata and Kajiwara 2009; Yasukata 2010; Yasukata and Kajiwara 2010). This phenomenon is referred to as "sticky costs" or "cost stickiness" (Anderson et al. 2003).

The empirical results of this paper indicate that when a decline in sales is expected on a year-to-year basis, the absolute value of the forecasted rate of change in costs is greater than the absolute value of the actual rate of change in costs. Conversely, when an increase in sales is expected on a year-to-year basis, the absolute value of the forecasted rate of change in costs is not different from the absolute value of the actual rate of change. These findings imply that the forecasted rate of change in costs is accurate when an increase in sales is expected, but it is overestimated when a decrease in sales is expected.

These findings contribute to accounting research in the following ways. First, the results provide a partial explanation for management forecast bias. Previous studies of management earnings forecasts reveal that they tend to be overestimated, upward-biased, or optimistic; that is, forecasted earnings are greater than reported earnings (Ota 2006; Kato et al. 2009). This optimism can be explained by managers' overestimation of cost reductions. The empirical results of this paper show that costs do not decrease to the level managers expect.

Second, Kato et al. (2009, p.1576) point out that managers' forecast optimism could be attributed to an internal budget with tight financial targets when it can be supposed that management forecasts are linked with an internal budget.[2] Recent questionnaire surveys on management forecasts reveal the process through which management forecasts were made. For example, the Japan Investor Relations Association conducted a questionnaire survey in 2011 and found that 74.1% of management forecasts are made on the basis of internal budgets.[3] Another questionnaire survey revealed that in 72.3% of respondent companies, management forecasts were identical with internal budget targets (Tsumuraya 2009). When management forecasts are identical with internal budget targets, managerial optimism in earnings forecasts can be attributed to an overestimation of sales and/or an underestimation of budgeted costs. The findings in this paper suggest that the budgeted reductions in costs are unattainable in many cases and costs are underestimated in management forecasts, resulting in a negative variance between budgeted costs (thus forecasted costs) and reported costs.

The remainder of this paper is organized as follows: Section 2 discusses the rate of change in costs on the basis of previous studies on the earnings benchmark and cost stickiness. Section 3 derives the actual cost fluctuation model from the model used for research on cost stickiness. In Section 4, the managers' cost prediction model is specified on the basis of the actual cost fluctuation model. Section 5 describes the sample for regression analysis and discusses its descriptive statistics. Section 6 presents the empirical results and Section 7 summarizes and discusses the findings of the study.

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[2] The other reasons that Kato et al. (2009) point out are managers' overconfidence, behavioral bias, and managerial opportunism (poorly performing managers portray their firm's performance as overly favorable).

[3] The survey results are available at https://www.jira.or.jp/.

2. Earnings Benchmarks and the Forecasted Rate of Change in Costs

Previous studies on earnings benchmarks have shown that managers are under pressure to achieve the benchmarks and that the preceding year's earnings are recognized as the benchmark to achieve (Burgstahler and Dichev 1997; Degeorge et al. 1999; Burgstahler and Eames 2006; Graham et al. 2005, 2006; Suda and Hanaeda 2008). Earnings benchmarks are important for managers; if managers do not meet these benchmarks, stock prices decline steeply and managers' bonuses and other rewards are reduced (Bartov et al. 2002; Skinner and Sloan 2002; Shuto 2007). These studies suggest that managers attempt to achieve consecutive growth in earnings by reducing costs. Especially when sales are expected to decline, large reductions in costs are necessary to attain an earnings benchmark equal to the preceding year's earnings. The emphasis on consecutive growth in earnings can be considered as one of the causes of the optimism in management earnings forecasts that Ota (2006) and Kato et al. (2009) report in their research.

On the basis of these empirical findings, managers' predictions of costs are likely to be smaller than actual costs. Thus, when a decrease in sales is expected, it can also be expected that the forecasted rate of decrease in costs will be greater than the actual rate of decrease. Conversely, when sales are expected to increase, managers do not always reduce costs in order to achieve an earnings benchmark. Instead, they would allow additional costs to maximize earnings with an increase in sales. When an increase in sales is expected, therefore, the relationship between the forecasted rate of increase in costs and the actual rate of increase cannot be predicted.

3. Sticky Cost Behavior and Actual Cost Fluctuation Model

Recent management accounting research on cost behavior has revealed that costs increase in response to an increase in sales; however, costs do not decline proportionately with a decrease in sales (Anderson et al. 2003). This phenomenon is referred to as sticky costs. Sticky cost behavior has been found by estimating Equation (1), which was used by Anderson et al. (2003) and has been used as a platform for cost behavior analysis in previous empirical studies.

$$ln\frac{C^r_{i,t}}{C^r_{i,t-1}} = \alpha^r + (\beta^r_1 + \beta^r_2 * DD^r) * ln\frac{S^r_{i,t}}{S^r_{i,t-1}} + \varepsilon^r_{i,t} \tag{1}$$

where

$C^r_{i,t}$ denotes costs reported for fiscal year t;

$S^r_{i,t}$ denotes sales reported for fiscal year t;

DD^r denotes a "decrease dummy:" a dummy variable that equals 1 if $S^r_{i,t}$ is less than $S^r_{i,t-1}$, and 0 otherwise.

The logarithm specification of this model lowers the risk of heteroskedasticity and allows for economic interpretation of the estimated coefficients. Because the value of DD^r is 0 when sales during fiscal year t increase in comparison to sales during fiscal year $t-1$, the coefficient β_1 measures the percentage increase in costs with 1% increase in sales. Further, because the value of DD^r is 1 when sales during fiscal year t decrease in comparison to sales during fiscal year $t-1$, the coefficient $\beta_1 + \beta_2$ measures the percentage decrease in costs with 1% decrease in sales.[4] If costs are sticky, the percentage change in costs when $DD^r = 0$ is greater than the percentage change in costs when $DD^r = 1$. Previous empirical studies show that cost stickiness exists by empirically testing the hypothesis that $\beta_2 < 0$. In this paper, Equation (1) is used as the "actual cost fluctuation model" since this equation is estimated on the basis of actual costs and sales reported in financial statements.

[4] Consider the following equation: $lnY_i = \beta_0 + \beta_1 lnX_i + \varepsilon_i$ and differentiate Y_i with respect to X_i. It follows that $\frac{dY_i}{dX_i}/Y_i = \beta_1/X_i$ from the differential formula. Thus, $\beta_1 = \frac{dY_i}{dX_i}/\frac{Y_i}{X_i} = \frac{dY_i}{Y_i}/\frac{dX_i}{X_i}$.

4. Managers' Cost Prediction Model

4.1 Managers' Cost Prediction Model

On the basis of the actual cost fluctuation model, Equation (1), the managers' cost prediction model, Equation (2), can be specified as follows:

$$ln\frac{C_{i,t}^{f}}{C_{i,t-1}^{r}} = \alpha^{f} + (\beta_1^{f} + \beta_2^{f} * DD^{f}) * ln\frac{S_{i,t}^{f}}{S_{i,t-1}^{r}} + \varepsilon_{i,t}^{f} \quad (2)$$

where

$C_{i,t}^{f}$ denotes costs of fiscal year t forecasted by managers;

$S_{i,t}^{f}$ denotes sales of fiscal year t forecasted by managers;

DD^{f} denotes a "decrease dummy:" a dummy variable that equals 1 if $S_{i,t}^{f}$ is less than $S_{i,t-1}^{r}$, and 0 otherwise.

4.2 Cost Forecast Errors

The primary interest of this paper is in the managers' prediction of costs of their company. If managers fully understand their company's cost behavior, it is expected that the coefficient of $(\beta_1^{r} + \beta_2^{r} * DD^{r})$ in Equation (1) equals the coefficient of $(\beta_1^{f} + \beta_2^{f} * DD^{f})$ in Equation (2). However, in this paper, these coefficients are estimated through regression analysis; it is impossible to compare these coefficient estimates because Equation (1) and Equation (2) are two different regression models altogether.

In order to make these coefficient estimates comparable, Equation (1) and Equation (2) are aggregated by subtracting Equation (1) from Equation (2).[5] This subtraction results in Equation (3), where $ln(C_{i,t}^{f}/C_{i,t}^{r})$ is the cost forecast error. Thus Equation (3) is a model that explains cost forecast errors.

$$ln\frac{C_{i,t}^{f}}{C_{i,t}^{r}} = \alpha + (\beta_1^{f} + \beta_2^{f} * DD^{f}) * ln\frac{S_{i,t}^{f}}{S_{i,t-1}^{r}} - (\beta_1^{r} + \beta_2^{r} * DD^{r}) * ln\frac{S_{i,t}^{r}}{S_{i,t-1}^{r}} + \varepsilon_{i,t} \quad (3)$$

where

$\alpha = \alpha^{f} - \alpha^{r}$ and $\varepsilon_{i,t}^{f} - \varepsilon_{i,t}^{r} = \varepsilon_{i,t}$.

Equation (3) implies that cost forecast errors, $ln(C_{i,t}^{f}/C_{i,t}^{r})$, can be explained by four elements: $(\beta_1^{f} + \beta_2^{f} * DD^{f})$, $ln(S_{i,t}^{f}/S_{i,t-1}^{r})$, $(\beta_1^{r} + \beta_2^{r} * DD^{r})$ and $ln(S_{i,t}^{r}/S_{i,t-1}^{r})$.

4.3 Explaining Cost Forecast Errors

In order to simplify the argument, assume that $DD^{f} = 0$ and $DD^{r} = 0$, which means that a decline in sales is not forecasted and sales actually do not decline; thus, an increase in sales is forecasted and sales actually increase. For this situation, Equation (1) and Equation (2), and thus, Equation (3), which explains the cost forecasts errors, are illustrated in Figure 1. Figure 1 indicates that four elements in Equation (3) can be aggregated into two factors that affect the magnitude of cost forecast errors; one is $ln(S_{i,t}^{f}/S_{i,t}^{r})$, which is derived from the aggregation of $ln(S_{i,t}^{f}/S_{i,t-1}^{r})$ and $ln(S_{i,t}^{r}/S_{i,t-1}^{r})$; the other is $(\beta_1^{f} - \beta_1^{r})$, which is derived from the aggregation of β_1^{f} and β_1^{r}. In case $|\beta_1^{f}| = |\beta_1^{r}|$, the cost forecast errors, $C_{i,t}^{f}/C_{i,t}^{r}$ or $ln(C_{i,t}^{f}/C_{i,t}^{r})$, can be explained by the sales forecast errors, namely, $S_{i,t}^{f}/S_{i,t}^{r}$ or $ln(S_{i,t}^{f}/S_{i,t}^{r})$ given $S_{i,t}^{f} \neq S_{i,t}^{r}$. Thus, when $|\beta_1^{f}| = |\beta_1^{r}|$, it can be said that managers accurately predict the rate of increase in costs of their company.

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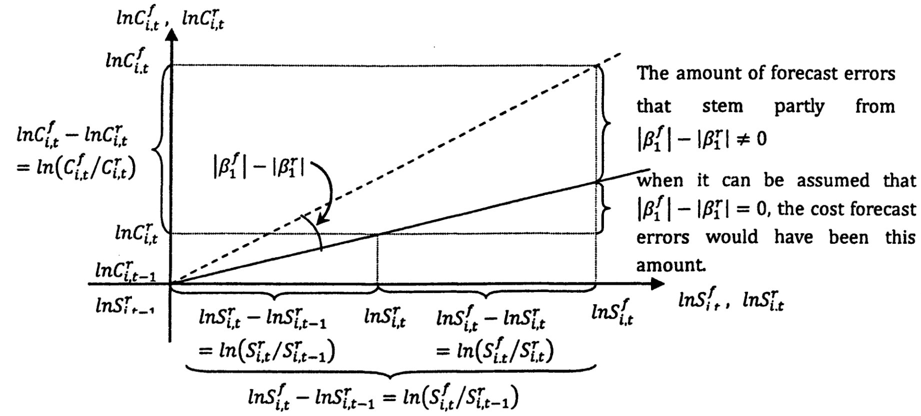
[5] Subtraction of Equation (1) from Equation (2) gives $ln\frac{C_{i,t}^{f}}{C_{i,t-1}^{r}} - ln\frac{C_{i,t}^{r}}{C_{i,t-1}^{r}} = \alpha^{f} - \alpha^{r} + (\beta_1^{f} + \beta_2^{f} * DD^{f}) * ln\frac{S_{i,t}^{f}}{S_{i,t-1}^{r}} - (\beta_1^{r} + \beta_2^{r} * DD^{r}) * ln\frac{S_{i,t}^{r}}{S_{i,t-1}^{r}} + \varepsilon_{i,t}^{f} - \varepsilon_{i,t}^{r}$. Rewriting $\alpha^{f} - \alpha^{r} = \alpha$ and $\varepsilon_{i,t}^{f} - \varepsilon_{i,t}^{r} = \varepsilon_{i,t}$ gives $(lnC_{i,t}^{f} - lnC_{i,t-1}^{r}) - (lnC_{i,t}^{r} - lnC_{i,t-1}^{r}) = \alpha + (\beta_1^{f} + \beta_2^{f} * DD^{f}) * ln\frac{S_{i,t}^{f}}{S_{i,t-1}^{r}} - (\beta_1^{r} + \beta_2^{r} * DD^{r}) * ln\frac{S_{i,t}^{r}}{S_{i,t-1}^{r}} + \varepsilon_{i,t}$. Equation (3) follows from $(lnC_{i,t}^{f} - lnC_{i,t-1}^{r}) - (lnC_{i,t}^{r} - lnC_{i,t-1}^{r}) = ln\frac{C_{i,t}^{f}}{C_{i,t}^{r}}$.

Figure 1- Illustrating Cost Forecast Errors when $DD^f = 0$ and $DD^r = 0$

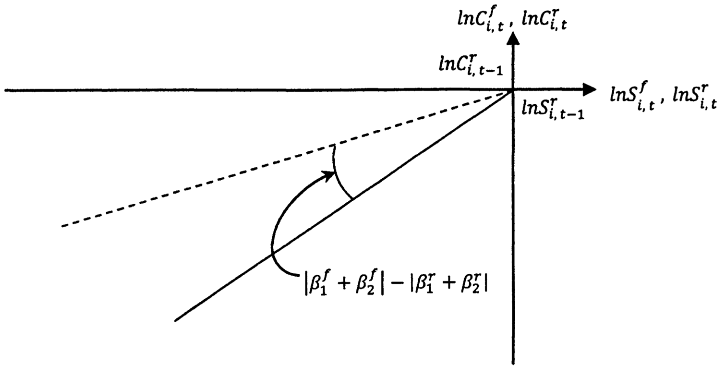


———————— Equation (1): Actual Cost Fluctuations Model with Coefficient $(\beta^r_1 + \beta^r_2 * DD^r)$

- - - - - - - - - - Equation (2): Managers' Costs Forecast Model with Coefficient $(\beta^f_1 + \beta^f_2 * DD^f)$

Given the sales-related variables, $S^f_{i,t}$, $S^r_{i,t}$ and $S^r_{i,t-1}$, namely, given $ln(S^f_{i,t}/S^r_{i,t-1})$, $ln(S^r_{i,t}/S^r_{i,t-1})$ and $ln(S^f_{i,t}/S^r_{i,t})$, as illustrated in Figure 2, if $|\beta^f_1| > |\beta^r_1|$, it can be said that managers overestimate the rate of increase in costs, resulting in overestimation of costs when managers forecast their companies' earnings. Overestimation of costs results in an underestimation of earnings. Conversely, if $|\beta^f_1| < |\beta^r_1|$, it can be said that managers underestimate the rate of increase in costs, resulting in underestimation of costs when managers forecast their companies' earnings. Underestimation of costs results in an overestimation of earnings.

Figure 2- Illustrating Cost Forecast Errors when $DD^f = 1$ and $DD^r = 1$



———————— Equation (1): Actual Cost Fluctuations Model with Coefficient $(\beta^r_1 + \beta^r_2 * DD^r)$

- - - - - - - - - - Equation (2): Managers' Costs Forecast Model with Coefficient $(\beta^f_1 + \beta^f_2 * DD^f)$

Next, suppose that $DD^f = 1$ and $DD^r = 1$, which means that a decline in sales is forecasted and sales actually decline. For this situation, Equation (1) and Equation (2), and thus, Equation (3), which explains the cost forecasts errors, are illustrated in Figure 2. When $\beta_1^f + \beta_2^f = \beta_1^r + \beta_2^r$, it can be said that managers accurately predict the rate of decrease in costs of their company. If $\beta_1^f + \beta_2^f > \beta_1^r + \beta_2^r$, the rate of decrease in costs could be overestimated by managers. Conversely, If $\beta_1^f + \beta_2^f < \beta_1^r + \beta_2^r$, as illustrated in Figure 2, it could be underestimated by managers.

4.4 Advantage of this Approach

The major advantage of this approach is that costs are expressed as a function of sales. Although an earnings forecast error has been analyzed by comparing the mean value of forecast errors, the mean value of $C_{i,t}^f/C_{i,t}^r$ does not provide enough information about cost forecast errors. If the mean value of $C_{i,t}^f/C_{i,t}^r$ is greater than 1 (hence, $ln(C_{i,t}^f/C_{i,t}^r)$ is greater than 0), it actually means that costs are overestimated; however, this does not explain why the mean value of $C_{i,t}^f/C_{i,t}^r$ is greater than 1. One plausible reason is that managers overestimate sales forecasts and consequently, costs are overestimated because theoretically, costs are resources sacrificed to generate sales, and costs increase as sales increase. Nevertheless, even if this is true and the mean value of $S_{i,t}^f/S_{i,t}^r$ is greater than 1 (hence, $ln(S_{i,t}^f/S_{i,t}^r)$ is greater than 0), $S_{i,t}^f/S_{i,t}^r$ does not explain anything about costs, because the mean value of $C_{i,t}^f/C_{i,t}^r$ and the mean value of $S_{i,t}^f/S_{i,t}^r$ are treated independently in the analysis.

This paper's functional form approach toward cost forecast errors views costs in relationship with sales. In addition, the approach disaggregates earnings into costs and sales, providing more information than earnings alone. Thus, this paper's approach is expected to provide rich insights into forecast errors of earnings as well as costs and sales.

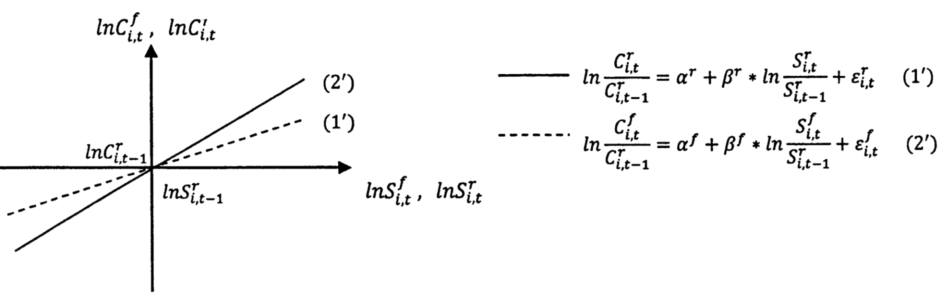
4.5 Incorporating Sticky Cost Behavior into the Analysis

DD^r in the actual cost fluctuation model, Equation (1), and DD^f in the managers' cost prediction model, Equation (2), allow analysis of sticky cost behavior. Again, DD^r is a dummy variable representing the situation in which $S_{i,t}^r < S_{i,t-1}^r$ and DD^f is a dummy variable representing the situation in which $S_{i,t}^f < S_{i,t-1}^r$. These two dummy variables are very important for investigating cost behavior. To see this, formulate Equation (1) as Equation (1′) and Equation (2) as Equation (2′) as follows:

$$ln\frac{C_{i,t}^r}{C_{i,t-1}^r} = \alpha^r + \beta^r * ln\frac{S_{i,t}^r}{S_{i,t-1}^r} + \varepsilon_{i,t}^r \qquad (1')$$

$$ln\frac{C_{i,t}^f}{C_{i,t-1}^r} = \alpha^f + \beta^f * ln\frac{S_{i,t}^f}{S_{i,t-1}^r} + \varepsilon_{i,t}^f \qquad (2')$$

Figure 3- Illustrating Equation (1′) and Equation (2′)



If the estimation of Equation (1′) and Equation (2′) shows that $\beta^f > \beta^r$, as shown in Figure 3, then the results provide evidence that the rate of change in costs is overestimated by managers when $S^r_{i,t} > S^r_{i,t-1}$ and $S^f_{i,t} > S^r_{i,t-1}$, and underestimated when $S^r_{i,t} < S^r_{i,t-1}$ and $S^f_{i,t} < S^r_{i,t-1}$.

It is obvious that the formulation of Equation (1′) and Equation (2′) and the estimation of them misrepresent the managers' ability to forecast costs because conclusions are affected by the direction of change in sales. This suggests that DD^r and DD^f be incorporated into Equation (1′) and Equation (2′) to distinguish the situation in which sales decline. Two dummy variables, DD^r and DD^f, play an important role in the empirical investigation of cost stickiness and in the prevention of conclusions being affected by the direction of change in sales.

4.6 Managers' Predictions of Costs and Coefficients in Equation (3)

The inclusion of two dummy variables, DD^r and DD^f, creates four situations that are derived from the combination of the dummy variables. The four situations are as follows: (DD^r, DD^f)=$(0,0)$, $(0,1)$, $(1,0)$ and $(1,1)$. Table 1 summarizes the relationship between managers' predictions of costs and coefficient estimates for these four situations.

If managers accurately forecast the direction of change in sales, then β^f_1 and β^r_1 can be comparable. When $(DD^f, DD^r) = (0,0)$ and if managers accurately predict the rate of change in costs, it can be expected that $\beta^f_1 = -\beta^r_1$, or $|\beta^f_1| = |\beta^r_1|$. If managers overestimate the rate of change in costs, it can be expected that $\beta^f_1 > -\beta^r_1$, or $|\beta^f_1| > |\beta^r_1|$. If managers underestimate the rate of change in costs, it can be expected that $\beta^f_1 < -\beta^r_1$, or $|\beta^f_1| < |\beta^r_1|$.

Table 1- Managers' predictions of costs and the coefficients

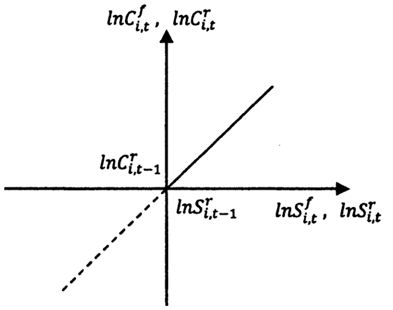
Forecasted sales	Actual sales	If managers accurately understand the rate of change in costs, coefficients would be...	If managers overestimate the rate of change in costs, coefficients would be...	If managers underestimate the rate of change in costs, coefficients would be...
Increase ($DD^f = 0$)	Increase ($DD^r = 0$)	$\beta^f_1 = -\beta^r_1$ or $\|\beta^f_1\| = \|\beta^r_1\|$	$\beta^f_1 > -\beta^r_1$ or $\|\beta^f_1\| > \|\beta^r_1\|$	$\beta^f_1 < -\beta^r_1$ or $\|\beta^f_1\| < \|\beta^r_1\|$
Decrease ($DD^f = 1$)	Decrease ($DD^r = 1$)	$\beta^f_1 + \beta^f_2 = -(\beta^r_1 + \beta^r_2)$ or $\|\beta^f_1 + \beta^f_2\| = \|\beta^r_1 + \beta^r_2\|$	$\beta^f_1 + \beta^f_2 > -(\beta^r_1 + \beta^r_2)$ or $\|\beta^f_1 + \beta^f_2\| > \|\beta^r_1 + \beta^r_2\|$	$\beta^f_1 + \beta^f_2 < -(\beta^r_1 + \beta^r_2)$ or $\|\beta^f_1 + \beta^f_2\| < \|\beta^r_1 + \beta^r_2\|$
Increase ($DD^f = 0$)	Decrease ($DD^r = 1$)	NA	NA	NA
Decrease ($DD^f = 1$)	Increase ($DD^r = 0$	NA	NA	NA

Equation (3): $ln\frac{c^f_{i,t}}{c^r_{i,t}} = \alpha + (\beta^f_1 + \beta^f_2 * DD^f) * ln\frac{s^f_{i,t}}{s^r_{i,t-1}} - (\beta^r_1 + \beta^r_2 * DD^r) * ln\frac{s^r_{i,t}}{s^r_{i,t-1}} + \varepsilon_{i,t}$

Similarly, when $(DD^f, DD^r) = (1,1)$ and if managers accurately understand the rate of change in costs, it can be expected that $\beta^f_1 + \beta^f_2 = -(\beta^r_1 + \beta^r_2)$, or $|\beta^f_1 + \beta^f_2| = |\beta^r_1 + \beta^r_2|$. If managers overestimate the rate of change in costs, it can be expected that $\beta^f_1 + \beta^f_2 > -(\beta^r_1 + \beta^r_2)$, or $|\beta^f_1 + \beta^f_2| > |\beta^r_1 + \beta^r_2|$. If managers underestimate the rate of change in costs, it can be expected that $\beta^f_1 + \beta^f_2 < -(\beta^r_1 + \beta^r_2)$, or $|\beta^f_1 + \beta^f_2| < |\beta^r_1 + \beta^r_2|$.

Meanwhile, if managers do not accurately forecast the direction of change in sales, it is difficult to interpret the coefficients. Consider the case of $(DD^f, DD^r) = (1,0)$ and $\beta^f_1 + \beta^f_2 = \beta^r_1$ as shown in Figure 4. This is the case in which sales actually increase (hence, $DD^r = 0$), although managers take sticky cost behavior into consideration in predicting costs when they forecast a decrease in sales (hence, $DD^f = 1$). Nevertheless, what $\beta^f_1 + \beta^f_2 = \beta^r_1$ means is unclear. Only if $\beta^r_2 = 0$ does $\beta^f_1 + \beta^f_2 = \beta^r_1$ indicate that managers fully understand the cost behavior of their company. However, the estimation of Equation (3) through regression analysis indicates nothing about β_2^r when $(DD^f, DD^r) = (1,0)$. The same is true for coefficient estimates under the condition of $(DD^f, DD^r) = (0,1)$. When $(DD^f, DD^r) = (0,1)$, the estimation of Equation (3) indicates nothing about β_2^f either. This paper focuses on the situation in which forecasted sales and actual sales move in the same direction: $(DD^f, DD^r) = (0,0)$ and $(1,1)$, so that coefficient estimates in Equation (3) can be compared.

Figure 4- Illustrating Equation (1) and Equation (2) when $(DD^f, DD^r) = (1,0)$



$$\text{———} \quad ln\frac{C_{i,t}^r}{C_{i,t-1}^r} = \alpha^r + \beta^r * ln\frac{S_{i,t}^r}{S_{i,t-1}^r} + \varepsilon_{i,t}^r \qquad (1)$$

$$\text{------} \quad ln\frac{C_{i,t}^f}{C_{i,t-1}^r} = \alpha^f + (\beta_1^f + \beta_2^f * DD^f) * ln\frac{S_{i,t}^f}{S_{i,t-1}^r} + \varepsilon_{i,t}^f \qquad (2)$$

5. Sample and Descriptive Statistics

5.1 Operating Costs

For years, companies listed on the stock exchanges in Japan have issued management forecasts of sales, earnings before extraordinary items and taxes (EBET), and net income for the fiscal year t+1 in the financial reports of fiscal year t. In addition, they have also issued operating income since 2008. Both operating income and EBET are reported in the income statement. The difference between EBET and operating income is that the former is calculated from the formula: EBET = operating income + interest income and dividends – interest expense. Reporting EBET in the income statement is one of the distinctive features of the Japanese accounting standard. EBET reflects both operating and financing activities, but it does not include profits and losses that stem from extraordinary events, such as natural disaster, and non-recurring events, such as restructuring. The Japanese accounting standard places emphasis on the distinction between recurring activities and non-recurring activities, as well as on the distinction between operating activities and financing activities.

In this study, forecasted cost information is derived by subtracting operating income from sales, reflecting a focus on operating costs. A disadvantage of using operating costs is that the number of observations is small because Japanese companies have issued management forecasts of operating income only since 2008; in contrast, total costs are available for more than 20 years. Therefore, the regression model is estimated based on a relatively small sample and there is potentially higher risk that the estimated coefficient are biased (Moers 2006).

Nonetheless, estimating the regression model based on operating costs has an important advantage. By definition, operating costs do not reflect expenses from financing activities and extraordinary items. Therefore, the forecast error of these costs – the focus of this research – is not affected by non-recurring operating activities, extraordinary events and financing activities. Thus, the empirical results are not affected by non-recurring operating activities and extraordinary events that are difficult for managers to forecast; it can be expected that the "managers' cost prediction model" precisely reflects the managers' understanding of their firm's cost behavior.

5.2 Data Collection

The collected data are management forecasts of companies listed in Section 1 of the Tokyo Stock Exchange. Press releases announce management forecasts of the full-year sales and earnings for fiscal year t+1, together with the full-year financial reports of fiscal year t. This study uses these management forecasts, although they are updated on a quarterly basis in the quarterly financial reports.[6]

Forecasted sales and operating income and corresponding actual sales and operating income are collected with the database called NEEDS-financial QUEST. Japanese listed companies have issued operating income forecasts since 2008. The sample of this study covers three years, from 2008 to 2010. As a result, 3,676 firm-year observations of actual financial data and 3,671 firm-year observations of forecasted financial data are collected.

5.3 "Restricted" and "Full" Sample

The implicit assumption in formulating Equation (1) and Equation (2) is that costs will increase when sales increase; however, the sample includes observations where costs have increased when sales have decreased (or costs have decreased when sales have increased). From an empirical point of view, firm-year observations in which sales decline (hence, $DD^r = 1$ and $DD^f = 1$) and costs increase will have the effect of increasing the coefficient estimates β_2^r and β_2^f (decreasing the absolute value of β_2^r and β_2^f) given the existence of cost stickiness. In other words, β_2^r and β_2^f will be overestimated on the basis of the sample that includes those observations and hence, the degree of cost behavior will be under-evaluated.

In order to determine the impact of those observations on the empirical results, a second sample is developed, according to Anderson and Lanen (2007) and Weiss (2010), that consists of only firm-year observations for which costs and sales move in the same direction. As in Anderson and Lanen (2007) and Weiss (2010), this sample is referred to as a "restricted" sample, and the initial sample is a "full" sample.

The restricted sample consists of the observations that fulfill the conditions that $C_{i,t}^r > C_{i,t-1}^r$ when $DD^r = 0$ or $C_{i,t}^r < C_{i,t-1}^r$ when $DD^r = 1$ for actual financial data, and $C_{i,t}^f > C_{i,t-1}^r$ when $DD^f = 0$ or $C_{i,t}^f < C_{i,t-1}^r$ when $DD^f = 1$ for forecasted financial data. Compiling the restricted sample reduces 3,676 firm-year observations in the full sample to 3,453 for actual financial data and 3,671 firm-year observations in the full sample to 3,445 for forecasted data. These restricted samples are used to estimate Equation (1) and Equation (2). Moreover, as summarized in Table 1, Equation (3) should be estimated on the basis of the restricted sample that fulfills the condition of $(DD^r, DD^f) = (0,0)$ or $(1,1)$, in addition to the above conditions. Consequently, the restricted sample, which is used for estimating Equation (3), consists of 2,315 firm-year observations.

5.4 Descriptive Statistics

Table 2 indicates the summary of the restricted sample with which Equation (3) is estimated. This restricted sample consists of observations where sales and costs move in the same direction: $C_{i,t}^r > C_{i,t-1}^r$ when $DD^r = 0$ or $C_{i,t}^r < C_{i,t-1}^r$ when $DD^r = 1$ for actual financial data; or $C_{i,t}^f > C_{i,t-1}^r$ when $DD^f = 0$ or $C_{i,t}^f < C_{i,t-1}^r$ when $DD^f = 1$ for forecasted financial data, and forecasted sales and actual sales move in the same direction: $(DD^f, DD^r) = (0,0)$ and $(1,1)$.

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[6] Listed firms on stock exchanges in Japan are also required to issue updated management forecasts when expected sales differ from the original forecast by 10% or more and expected earnings or losses are differ from the original forecast by 30% or more.

Table 2- Descriptive Statistics

Panel A: Overall restricted sample that fulfills $(DD^f, DD^r) = (0,0)$ or $(DD^f, DD^r) = (1,1)$

Forecast Error a)	Mean(%)	S.D. b)	Smallest(%)	1stQ c) (%)	Median(%)	3rdQ d) (%)	Largest(%)	N
Sales	5.03	11.98	-28.34	-1.05	3.05	9.19	107.31	2,328
Operating costs	4.27	9.13	-25.27	-0.69	3.15	8.13	68.67	2,330
Operating income	-2.32	401.16	-4805.88	-43.70	-6.65	25.98	4900.00	2,323

Forecast error a)	One-sample t test e)		Wilcoxon's signed-rank test f)	
	t value	Probability	Standardized W	Probability
Sales	20.25	0.000	20.69	0.000
Operating costs	22.56	0.000	22.47	0.000
Operating income	-0.28	0.780	-5.37	0.000

Panel B: Restricted sample that fulfills $(DD^f, DD^r) = (0,0)$

Forecast error a)	Mean(%)	S.D. b)	Median(%)	N	One-sample t test e)		Wilcoxon's signed-rank test f)	
					t value	Probability	Standardized W	Probability
Sales	1.93	7.46	1.19	815	7.40	0.000	7.68	0.000
Operating costs	1.82	7.04	1.13	817	7.40	0.000	7.74	0.000
Operating income	17.39	304.54	-0.57	813	1.63	0.104	0.97	0.331

Panel C: Restricted sample that fulfills $(DD^f, DD^r) = (1,1)$

Forecast error a)	Mean(%)	S.D. b)	Median(%)	N	One-sample t test e)		Wilcoxon's signed-rank test f)	
					t value	Probability	Standardized W	Probability
Sales	6.69	13.52	4.80	1,513	19.25	0.000	19.31	0.000
Operating costs	5.59	9.84	4.57	1,513	22.10	0.000	21.28	0.000
Operating income	-12.94	444.30	-13.21	1,510	-1.13	0.258	-6.41	0.000

a) A forecast error is calculated as follows: $[(\text{a predicted value}/\text{an actual value}) - 1]$ for each firm i and fiscal year t. A forecast error is converted into a percentage.

b) S.D. is standard deviation.

c) 1stQ is a 25th percentile.

d) 3rdQ is a 75th percentile.

e) H_0: mean $= 0$ vs. H_1: mean $\neq 0$

f) H_0: a forecast error $= 0$ vs. H_1: a forecast error $\neq 0$

Panel A shows characteristics of the overall restricted sample. The forecast error is calculated through $((\text{a predicted value}/\text{an actual value}) - 1)$ for each firm i and fiscal year t. The mean (median) of the sales forecast error and cost forecast error is 5.03% and 4.27% (3.05% and 3.15%), respectively. These forecast errors are different from zero based on a t-test and on Wilcoxon's signed-rank test, which indicates that, on average, managers overestimate both sales and costs when they predict either.

The mean (median) of the operating income forecast error is -2.32% (-6.65%), suggesting that sales are overestimated and/or costs are underestimated. Note that some absolute values of the operating income forecast errors may be extremely large when a denominator, namely, a preceding year's operating income, is close to zero. In case there are some extremely large operating income forecast errors in the sample, the mean of the operating income forecast errors does not represent the average of its distribution any longer. Additionally, accounting measures are considered not to be distributed symmetrically around the mean value, and it is recommended that more emphasis be placed on the Wilcoxon's signed-rank test for testing the median value than on the t-test for testing the mean value (Barber and Lyon 1997). On the basis of the signed-rank test, the median of the operating income forecast error is -6.65% and significantly different from zero.

Panel B illustrates descriptive statistics of the restricted sample that consists of observations under the condition of $(DD^f, DD^r) = (0, 0)$; sales are forecasted to increase, and sales actually increase. The mean (median) of the sales forecast error and cost forecast error is 1.93% and 1.82% (1.19% and 1.13%), respectively, all of which are significantly different from zero. Sales and costs are overestimated. Although the mean (median) of operating income forecast error is 17.39% (-0.57%), the median is not different from zero based on the signed-rank test, suggesting that the sales forecast errors and cost forecast errors are identical.[7]

Panel C illustrates descriptive statistics of the restricted sample that consists of observations under the condition of $(DD^f, DD^r) = (1, 1)$: sales are forecasted to decrease, and sales actually do decrease. The mean [median] of the sales forecast error and the cost forecast error is 6.69% and 5.59% (4.80% and 4.57%), respectively. They are significantly different from zero. Sales and costs are overestimated. However, the median of operating income is -13.21% and statistically different from zero-based on the signed-rank test, which implies that the amount of costs forecast error is larger than the amount of sales forecast error.

6. Empirical Tests

6.1 Preliminary Tests

Although it is impossible to compare the coefficients of Equation (1) with those of Equation (2) because they are two different regression models, Equation (1) and Equation (2) are estimated as preliminary tests. Previous studies reveal that management earnings forecasts tend to be overestimated or optimistic (i.e., forecasted earnings were larger than actual earnings) especially when the preceding year's reported net income was less than zero (Ota 2006). On the basis of this tendency, a control variable, Neg_E_{t-1}, is incorporated into Equation (1) and Equation (2). Neg_E_{t-1} is a dummy variable which equals 1 when the reported net income of fiscal year $t-1$ is less than zero, and equals 0 otherwise. Fiscal year dummy variables, FY_{2009} and FY_{2010}, are also added to Equation (1) and Equation (2) to control for the year. FY_{2009} (FY_{2010}) is a dummy variable that equals 1 when an observation is from fiscal year 2009' (2010'), and otherwise equals 0. As a result, Equation (4) and Equation (5) are developed. These equations are estimated on the basis of the full sample and the restricted sample, respectively.

$$ln\frac{C^r_{i,t}}{C^r_{i,t-1}} = \alpha^r + (\beta^r_1 + \beta^r_2 * DD^r) * ln\frac{S^r_{i,t}}{S^r_{i,t-1}} + \beta^r_3 * Neg\_E_{t-1}$$
$$+\beta^r_4 * FY_{2009} + \beta^r_5 * FY_{2010} + \varepsilon^r_{i,t} \qquad (4)$$

$$ln\frac{C^f_{i,t}}{C^r_{i,t-1}} = \alpha^f + (\beta^f_1 + \beta^f_2 * DD^f) * ln\frac{S^f_{i,t}}{S^r_{i,t-1}} + \beta^f_3 * Neg\_E_{t-1}$$

$$+\beta^f_4 * FY_{2009} + \beta^f_4 * FY_{2010} + \varepsilon^f_{i,t} \qquad (5)$$

[7] Earnings forecast error is defined in this paper as follows: $(E^f/E^r) - 1$. E^f denotes the forecasted earnings and E^r denotes the reported earnings. E^f is the difference between the forecasted sales and costs. Thus, $E^f = S^f - C^f$. S^f and C^f denote forecasted sales and costs, respectively. E^r is the difference between the reported sales and costs. Thus, $E^r = S^r - C^r$. S^r and C^r denote reported sales and costs, respectively. When earnings forecast error is zero, it follows that $(E^f/E^r) - 1 = 0$: thus, $E^f = E^r$. When $E^f = E^r$, it follows that $S^f - S^r = C^f - C^r$, from $E^f = S^f - C^f$ and $E^r = S^r - C^r$.

6.2 Estimation of Equation (4) and Equation (5)

Table 3 reports the estimation of Equation (4) and Equation (5). $\hat{\beta}_1^r$ is the actual rate of change in costs when sales actually increase compared to the preceding fiscal year's sales. $\hat{\beta}_1^f$ is the forecasted rate of change in costs that managers use to predict costs when sales are expected to increase compared to the preceding fiscal year's sales. All of the coefficient estimates are statistically significant at the 0.1% level.

Table 3- Preliminary Analysis: Estimation of Equation (4) and Equation (5)

	Estimation of Equation (4)			Estimation of Equation (5)	
	Full sample	Restricted sample		Full sample	Restricted sample
$\hat{\alpha}^r$	0.014***	0.009**	$\hat{\alpha}^f$	0.004	-0.002
	[4.29]	[2.83]		[1.43]	[-0.80]
$\hat{\beta}_1^r$	0.938***	0.969***	$\hat{\beta}_1^f$	0.898***	0.966***
	[60.14]	[68.97]		[84.29]	[103.73]
$\hat{\beta}_2^r$	-0.160***	-0.187***	$\hat{\beta}_2^f$	-0.054***	-0.115***
	[-8.64]	[-11.15]		[-3.84]	[-9.47]
$\hat{\beta}_3^r$	-0.044***	-0.039***	$\hat{\beta}_3^f$	-0.056***	-0.052***
	[-17.40]	[-16.96]		[-26.90]	[-28.09]
$\hat{\beta}_4^r$	-0.007*	-0.005	$\hat{\beta}_4^f$	0.002	0.005
	[-2.19]	[-1.54]		[0.85]	[1.86]
$\hat{\beta}_5^r$	-0.036***	-0.031***	$\hat{\beta}_5^f$	-0.008**	-0.003
	[-10.44]	[-9.82]		[-2.76]	[-1.00]
$adj\ R^2$	0.883	0.910	$adj\ R^2$	0.911	0.940
N	3,676	3,453	N	3,671	3,445

***significant at the 0.1% level, ** significant at the 1% level, * significant at the 5% level

t-values are in square brackets.

Equation (4): $ln\frac{C_{i,t}^r}{C_{i,t-1}^r} = \alpha^r + (\beta_1^r + \beta_2^r * DD^r) * ln\frac{S_{i,t}^r}{S_{i,t-1}^r} + \beta_3^r * Neg\_E_{t-1} + \beta_4^r * FY_{2009} + \beta_5^r * FY_{2010} + \varepsilon_{i,t}^r$

Equation (5): $ln\frac{C_{i,t}^f}{C_{i,t-1}^r} = \alpha^f + (\beta_1^f + \beta_2^f * DD^f) * ln\frac{S_{i,t}^f}{S_{i,t-1}^r} + \beta_3^f * Neg\_E_{t-1} + \beta_4^f * FY_{2009} + \beta_4^f * FY_{2010} + \varepsilon_{i,t}^f$

$\hat{\beta}_1^r$ under the full sample is 0.938, and $\hat{\beta}_1^f$ under the full sample is 0.898. The full sample estimation suggests that managers predict a 0.898% increase in costs per 1% increase in sales while an actual increase in sales is 0.938% per 1% increase in sales. $\hat{\beta}_1^r$ under the restricted sample is 0.969, and $\hat{\beta}_1^f$ under the restricted sample is 0.966. The restricted sample estimation suggests that managers predict a 0.966% increase in costs per 1% increase in sales while an actual increase in sales is 0.969% per 1% increase in sales. $\hat{\beta}_1^r$ and $\hat{\beta}_1^f$ under the restricted sample estimation are larger than $\hat{\beta}_1^r$ and $\hat{\beta}_1^f$ under the full sample estimation, respectively. As predicted, this is because the full sample includes the firm-year observations where costs and sales move in a different direction. As a result, coefficient estimates in the full sample estimation are underestimated. Thus, more emphasis should be placed on the restricted sample estimation.

Although it is impossible to compare $\hat{\beta}_1^r$ with $\hat{\beta}_1^f$, the findings based on the restricted sample estimation imply that the managers seem to understand accurately the rate of change in costs when sales are expected to increase. With regard to cost stickiness, $\hat{\beta}_2^r$ and $\hat{\beta}_2^f$ are negative and significant at the 0.1% level for both full sample estimation and restricted sample estimation. A negative $\hat{\beta}_2^f$ suggests that managers understand the stickiness of operating costs. $(\hat{\beta}_1^r + \hat{\beta}_2^r)$ is 0.778 (0.938 – 0.160) under the full sample estimation and 0.782 (0.969 – 0.187) under the restricted sample estimation. The fact that $(\hat{\beta}_1^r + \hat{\beta}_2^r)$ is 0.782% under the restricted sample estimation (0.778% under the full sample estimation) indicates that operating costs decrease by 0.782% (0.778%) per 1% decrease in actual sales.

$(\hat{\beta}_1^f + \hat{\beta}_2^f)$ is 0.844 (0.898 – 0.054) under the full sample estimation and 0.851 (0.966 – 0.115) under the restricted sample estimation. It can be said, on the basis of the restricted sample estimation (on the basis of the full sample estimation), that managers predict that costs will decline by 0.851% (0.844%) when they forecast that sales will decline by 1%. On the basis of the findings that $(\hat{\beta}_1^f + \hat{\beta}_2^f)$ is larger than $(\hat{\beta}_1^r + \hat{\beta}_2^r)$ in the restricted sample estimation, managers seem to have a tendency to overestimate the rate of change in operating costs when they forecast declines in future sales. The preliminary analysis suggests that managers seem to accurately understand the rate of change in costs when predicting an increase in sales, although they do not seem to accurately understand the rate of change in costs when predicting a decrease in sales.

The independent variables in Equation (3) are $ln(S_{i,t}^f/S_{i,t-1}^r)$ and $ln(S_{i,t}^r/S_{i,t-1}^r)$. These two variables are highly correlated; the Pearson correlation between $ln(S_{i,t}^f/S_{i,t-1}^r)$ and $ln(S_{i,t}^r/S_{i,t-1}^r)$ is 0.692 when $(DD^f, DD^r) = (0,0)$, and the Pearson correlation between $ln(S_{i,t}^f/S_{i,t-1}^r)$ and $ln(S_{i,t}^r/S_{i,t-1}^r)$ is 0.631 when $(DD^f, DD^r) = (1,1)$. Therefore, an estimate of Equation (3) might be faced with multicollinearity. If multicollinearity has a serious impact on the estimation of Equation (3), the magnitude relationship among coefficient estimates for $\hat{\beta}_1^f$, $\hat{\beta}_2^f$, $\hat{\beta}_1^r$ and $\hat{\beta}_2^r$ based on the preliminary analysis would disappear. The magnitude relationship found in the preliminary analysis is one of the criteria for judging the existence of a multicollinearity problem in the estimation of Equation (3).

6.3 Equation (6) and its Estimation

As Equation (4) and Equation (5) are derived from adding the control variables to Equation (1) and Equation (2), respectively, the same control variables are added to Equation (3) to develop Equation (6).

$$ln\frac{C_{i,t}^f}{C_{i,t}^r} = \alpha + (\beta_1^f + \beta_2^f * DD^f) * ln\frac{S_{i,t}^f}{S_{i,t-1}^r} - (\beta_1^r + \beta_2^r * DD^r) * ln\frac{S_{i,t}^r}{S_{i,t-1}^r}$$
$$+\beta_3 * Neg\_E_{t-1} + \beta_4 * FY_{2009} + \beta_5 * FY_{2010} + \varepsilon_{i,t} \qquad (6)$$

Table 4 displays the results of estimating Equation (6), which is estimated on the basis of the restricted sample that consists of the observations where the following conditions are fulfilled: $(DD^f, DD^r) = (0,0)$ or $(1,1)$; $C_{i,t}^f > C_{i,t-1}^r$ and $C_{i,t}^r > C_{i,t-1}^r$ when $(DD^f, DD^r) = (0,0)$; and $C_{i,t}^f < C_{i,t-1}^r$ and $C_{i,t}^r < C_{i,t-1}^r$ when $(DD^f, DD^r) = (1,1)$.

Table 4- Estimation of Equation (6)

$\hat{\alpha}$	-0.003	[-1.16]
$\hat{\beta}_1^f$	0.871***	[57.79]
$\hat{\beta}_2^f$	-0.129***	[-7.58]
$\hat{\beta}_1^r$	-0.881***	[-52.74]
$\hat{\beta}_2^r$	0.155***	[8.49]
$\hat{\beta}_3$	-0.011***	[-6.15]
$\hat{\beta}_4$	0.008**	[3.11]
$\hat{\beta}_5$	0.018***	[6.53]
$adj\ R^2$	0.875	
N	2,315	

***significant at the 0.1% level, ** significant at the 1% level

t-values are in square brackets.

Equation (6): $ln\frac{C_{i,t}^f}{C_{i,t}^r} = \alpha + (\beta_1^f + \beta_2^f * DD^f) * ln\frac{S_{i,t}^f}{S_{i,t-1}^r} - (\beta_1^r + \beta_2^r * DD^r) * ln\frac{S_{i,t}^r}{S_{i,t-1}^r}$
$+\beta_3 * Neg\_E_{t-1} + \beta_4 * FY_{2009} + \beta_5 * FY_{2010} + \varepsilon_{i,t}$

6.4 Comparison between $\hat{\beta}_1^f$ and $\hat{\beta}_1^r$

The value of $\hat{\beta}_1^f$ is 0.871 and $\hat{\beta}_1^r$ is -0.881, both of which are statistically significant at the 0.1% level. The absolute value of $\hat{\beta}_1^f$ is 0.871, which means that managers predict that costs will increase by 0.871% when 1% increase in sales is forecasted. The absolute value of $\hat{\beta}_1^r$ is 0.881, which means that costs actually increase by 0.881% per 1% increase in sales.

With regard to multicollinearity, the variance inflation factors (hereafter VIF) of $ln(S_{i,t}^f/S_{i,t-1}^r)$ and $ln(S_{i,t}^r/S_{i,t-1}^r)$are 15.98 and 24.55, respectively, under the condition of $(DD^f, DD^r) = (0,0)$. As it is commonly understood, regression analysis could be faced with a serious multicollinearity problem if VIF is over 100 (Afifi et al. 2011, p.144). In addition, the findings that $|\hat{\beta}_1^f|$ is slightly smaller than $|\hat{\beta}_1^r|$ are consistent with the results of the preliminary test. It can be argued that the estimation of Equation (6), under the conditions of $(DD^f, DD^r) = (0,0)$, is not faced with a serious multicollinearity problem.

As summarized in Table 1, if $\beta_1^f + \beta_1^r = 0$, then managers accurately understand the rate of change in costs when predicting an increase in sales, and sales actually increase. If $\beta_1^f + \beta_1^r > 0$, managers overestimate the rate of change in costs; if $\beta_1^f + \beta_1^r < 0$, managers underestimate it.

In order to empirically test the hypothesis that $\beta_1^f + \beta_1^r = 0$, an F-test is applied to the following hypothesis:

$$\mathrm{H_{a0}}: \beta_1^f + \beta_1^r = 0 \ \ vs.\ \ \mathrm{H_{a1}}: \beta_1^f + \beta_1^r \neq 0$$

The F-statistic is 0.86 (1, 2307), and $\mathrm{H_{a0}}$ is not statistically rejected. Although the value of $|\hat{\beta}_1^f|$ is 0.871 and $|\hat{\beta}_1^r|$ is 0.881, the F-test indicates that managers accurately predict the rate of change in costs when they predict an increase in sales, and sales actually increase.

6.5 Comparison between $(\beta_1^f + \beta_2^f)$ and $(\beta_1^r + \beta_2^r)$

The value of $\hat{\beta}_2^r$ is 0.155 at the 0.1% level of statistical significance, which indicates the existence of cost stickiness. The value of $\hat{\beta}_2^f$ is -0.129 at the 0.1% level of statistical significance, which indicates that managers take sticky cost behavior into consideration when predicting costs. The absolute value of $\hat{\beta}_1^f + \hat{\beta}_2^f$ ($|\hat{\beta}_1^f + \hat{\beta}_2^f|$) is 0.742 (0.871 − 0.129), and the absolute value of $\hat{\beta}_1^r + \hat{\beta}_2^r$ ($|\hat{\beta}_1^r + \hat{\beta}_2^r|$) is 0.726 (−0.881 + 0.155). These findings suggest that managers predict that costs will decrease by 0.742% per 1% decline in sales; costs actually decrease by 0.726% per 1% decline in sales. The difference between the absolute value of $\hat{\beta}_1^f + \hat{\beta}_2^f$ and the absolute value of $\hat{\beta}_1^r + \hat{\beta}_2^r$ is 0.016. It is an empirical matter whether this difference is significantly different from zero.

With regard to multicollinearity, the VIFs of $DD^f * ln(S_{i,t}^f/S_{i,t-1}^r)$and $DD^r * ln(S_{i,t}^r/S_{i,t-1}^r)$ are 11.72 and 19.47, respectively, under the condition of $(DD^f, DD^r) = (1,1)$. The highest VIF value is still 24.55 for the variable $ln(S_{i,t}^r/S_{i,t-1}^r)$. In addition, the finding that $|\hat{\beta}_1^f + \hat{\beta}_2^f| = 0.742$ is larger than $|\hat{\beta}_1^r + \hat{\beta}_2^r| = 0.726$ is consistent with the results of the preliminary test. It can be inferred that the estimation of Equation (6) under the conditions of $(DD^f, DD^r) = (1,1)$ is not faced with a serious multicollinearity problem.

As summarized in Table 1, if $(\beta_1^f + \beta_2^f) + (\beta_1^r + \beta_2^r) = 0$, it can be inferred that managers accurately understand the rate of change in costs when they predict a decrease in sales and sales actually decrease. If managers overestimate the rate of change in costs, it can be expected that $(\beta_1^f + \beta_2^f) + (\beta_1^r + \beta_2^r) > 0$. If managers underestimate the rate of change in costs, it can be expected that $(\beta_1^f + \beta_2^f) + (\beta_1^r + \beta_2^r) < 0$.

In order to empirically test $(\beta_1^f + \beta_2^f) + (\beta_1^r + \beta_2^r) = 0$, an F-test is applied to the following hypothesis:

$$\mathrm{H_{b0}}: \beta_1^f + \beta_2^f + (\beta_1^r + \beta_2^r) = 0 \ \ vs.\mathrm{H_{b1}}: \beta_1^f + \beta_2^f + (\beta_1^r + \beta_2^r) \neq 0$$

The F-statistic is 8.98 (1, 2308), and $\mathrm{H_{b0}}$ is rejected at the 1% level of statistical significance. $(\hat{\beta}_1^f + \hat{\beta}_2^f)$ plus $(\hat{\beta}_1^r + \hat{\beta}_2^r)$ is 0.016 $\left((\hat{\beta}_1^f + \hat{\beta}_2^f) + (\hat{\beta}_1^r + \hat{\beta}_2^r) = 0.016\right)$, which indicates that managers overestimate the rate of change in costs by 0.016% when they predict 1% decrease in sales and sales actually do decrease by 1%. As mentioned, these findings are consistent with the prediction in Section 2 that when a decrease in sales is expected, it can also be expected that the forecasted rate of decrease in costs will be larger than the actual rate of decrease.

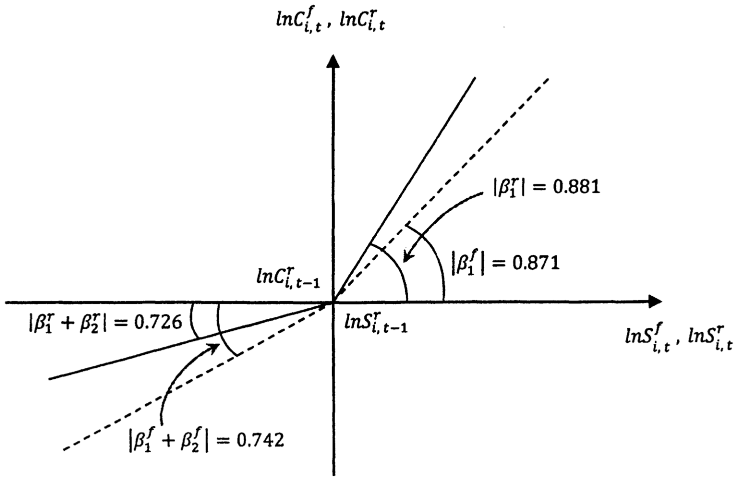
7. Discussion and Conclusion

7.1 Summary of Findings

Figure 5 illustrates the estimated coefficients: $\hat{\beta}_1^f$, $\hat{\beta}_2^f$, $\hat{\beta}_1^r$ and $\hat{\beta}_2^r$, and the estimated constant $\hat{\alpha}$ in Equation (6). In Figure 5, $\hat{\alpha}$ is regarded as zero because $\hat{\alpha}$ is not statistically different from zero. The estimation of Equation (6) results in findings that $\hat{\beta}_1^f$ is positive and $\hat{\beta}_1^r$ is negative, both of which are significant at the 0.1% level. $|\hat{\beta}_1^f|$ is 0.871 and $|\hat{\beta}_1^r|$ is 0.881; the difference between $|\hat{\beta}_1^f|$ and $|\hat{\beta}_1^r|$ in Equation (6) is 0.015 ($|\hat{\beta}_1^f| - |\hat{\beta}_1^r| = 0.015$). An F-test was conducted to examine empirically whether this difference is statistically significant. The F-test did not reject $\mathrm{H_{a0}}$: $\beta_1^f + \beta_1^r = 0$, suggesting that managers accurately predict the increase rate of change in costs when sales are expected to increase.

With regard to sales decline forecasts, the findings are that β_2^f is negative and significant in the estimation of both Equation (5) and Equation (6), implying that managers take sticky cost behavior into consideration when they make management forecasts. On the basis of the estimation of Equation (6), $|\hat{\beta}_1^f + \hat{\beta}_2^f|$ is 0.742 and $|\hat{\beta}_1^r + \hat{\beta}_2^r|$ is 0.726. The finding that $|\hat{\beta}_1^f + \hat{\beta}_2^f|$ is larger than $|\hat{\beta}_1^r + \hat{\beta}_2^r|$ in Equation (6) is consistent with the results of the preliminary test. The difference between $|\hat{\beta}_1^f + \hat{\beta}_2^f|$ and $|\hat{\beta}_1^r + \hat{\beta}_2^r|$ is 0.016 ($|\hat{\beta}_1^f + \hat{\beta}_2^f| - |\hat{\beta}_1^r + \hat{\beta}_2^r| = 0.016$). An F-test was conducted to empirically examine whether this difference is statistically significant. The F-test rejected $\mathrm{H_{b0}}$: $\beta_1^f + \beta_2^f = -(\beta_1^r + \beta_2^r)$, suggesting that there is a statistical significance in the difference between the forecasted rate of decrease in costs and the actual rate of decrease in costs. It can be concluded that managers tend to overestimate the rate of decrease in costs slightly when sales are expected to decrease.

Figure 5- Illustrating the estimation of Equation (6)



Because $\hat{\alpha}$ is -0.003 and is not significantly different from zero Equation (6) is described as a function that passes through the origin of the coordinates.

7.2 Implications for Management Forecast Research

The findings in this paper suggest that the bias in management earnings forecasts tends to be larger when sales are expected to decline because the forecasted rate of decrease in costs is larger than the actual rate of decrease when sales are expected to decline. This tendency would result in an overestimation of earnings. Meanwhile, there is no difference between the forecasted rate of increase in costs and the actual increase when sales are expected to increase.

These findings are consistent with the descriptive statistics in Table 2. Wilcoxon's signed-rank test shows that the median value of the forecast error of operating income is -13.21% when sales are expected to decline, and it is significantly different from zero, while the median of the operating income forecast error is not different from zero when sales are expected to increase.

If the budget targets and management forecasts are identical, the findings of this paper imply that not only do managers underestimate cost stickiness but they also set ambitious cost reduction targets when sales are likely to decline. The preceding year's earnings are the benchmark of the financial performance of a company. Managers may have to set cost reduction targets to meet the benchmark, although those targets are difficult to achieve.

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