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The Effect of Sales Downside Risk on Cost Stickiness

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Abstract

Understanding the behavior of cost is essential in managerial accounting. This paper is about managers' cost decisions under uncertainty, specifically whether managers understand risk on sales and incorporate such risk into cost decisions. Following method of calculating earnings downside risk, I constructed a sales expectation model and measured sales downside risk, and evaluated how managers react to sales downside risk. I find that: (1) under sales downside risk, managers have cost structure with lower fixed costs and higher variable costs, resulting in less sticky cost behavior; (2) under sales overall risk, managers have cost structure with higher fixed costs and lower variable cost, resulting in more sticky cost behavior; (3) managers care more about risk on sales than risk on earnings when they make cost decisions; and (4) high-ability managers better understand such risks than low-ability managers.

Keyword : Cost stickiness, Sales downside risk, Sales total risk, Earnings downside risk, Earnings total risk, Managerial ability

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1. Introduction

Cost behavior is one of the crucial factors for managers to understand in deciding cost structure in response to sales revenue. In this paper, I focus on the effect of sales downside risk and sales uncertainty on cost behavior. Following Banker et al. (2014), where they argue that firms choose more rigid cost structure with high fixed and low variable cost when they face high demand uncertainty, I examine both sales downside risk and sales uncertainty and how those two risks play different roles in cost behavior.

Cost is described mainly as fixed and variable costs with a change of sales volume. The traditional cost model argues that variable costs change proportionately with changes in the sales activity (Noreen 1991). In other words, degree of change in cost depends only on the level of sales change, not on the direction of the sales change.

However, Anderson et al. (2003) found the evidence that degree of change in SG&A cost relies on the direction of change in revenue, arguing that costs fall less when sales decrease than costs rise when sales increase. They label this type of cost behavior as sticky cost or asymmetry cost behavior.

Sticky cost arises because managerial discretion affects the resource adjustment process (Anderson et al. 2003). When sales increase, managers increase resources to accommodate additional sales. When sales decreases, however, some of the committed resources are left unused unless managers decide to reduce remaining resources. If managers decide to remove the resources, they have to incur adjustment costs such as severance pay, search, and training costs when the level of sales will pick up in the future. And high fixed resources such as asset, employees will incur more adjustment cost than variable cost. Therefore, if the firm has more fixed resources, its cost will show more sticky behavior. Because sales change is stochastic, managers should assess the possibility whether the drop-in sales is temporary or not before they decide to remove the committed resources. Therefore, uncertainty on sales is likely affect manager's decision on cost structure (Banker at el. 2014). Especially when the manager faces downside risk on sales, managers prefer a less rigid short-run cost structure with relatively low fixed costs to variable costs. Balakrishnan, Sivaramakrishnan, and Sprinkle (2008) state that "cost structure with less operating leverage (i.e., a lower proportion of fixed costs) offers companies flexibility because it involves fewer upfront cost commitments (i.e., fewer fixed costs). Companies confronting uncertain and fluctuating demand conditions are likely to opt for this flexibility". Kallapur and Eldenburg (2005), who focus on contribution margin uncertainty, states that "because the value of flexibility increases with uncertainty, technologies with high variable and low fixed costs become more attractive as uncertainty increases." Thus, firms facing high downside risk on sales should choose less rigid cost structure with low fixed costs and high variable costs (Banker et al. 2014). And high variable cost and low fixed cost results in lower degree of cost asymmetry.

On the other hand, Banker et al. (2014) argue that when managers face high demand uncertainty, manager decide to choose more rigid cost structure with more fixed costs and less variable costs. In line with logic of Banker et al. (2014), when sales uncertainty increases, likelihood of both unusually high and low level of sales rises. In the situation of unusually high sales, capacity of fixed resource would be limited, resulting in disproportionately large congestion cost.

In other words, when sales uncertainty increases, congestion happens more frequently and lead to more worse circumstance. In response to sales uncertainty, managers increase the fixed resources to ease the congestion. Therefore, cost structure becomes more rigid with high fixed costs and low variable costs. And low variable cost and high fixed cost results in higher degree of cost asymmetry.

In line of arguments mentioned, I hypothesize that firm facing future downside risk on sales have less rigid short-run cost structure with low fixed cost and high variable costs, showing less sticky cost bahavior. And firm facing high future uncertainty on sales have more rigid short-run cost structure with high fixed costs and low variable costs, showing more sticky cost behavior.

I test this hypothesis by constructing the measure, which captures above and below-expectation volatility of sales. Konchitchki et al. (2015) constructed earnings downside risk (EDR) measure, which captures the expectation for future downward operating performance using financial statements. I follow methodology of Konchitchki et al. (2015) and extend it to sales revenue instead of earnings (ROA). To calculate the downside expectation of sales, following Konchitchki et al. (2015), I estimate a sales expectation model and use a probability-weighted function of below-expectation relative to above-expectation residuals (i.e., sales revenue surprises), and I label such measure as sales downside risk (SDR). Also, to calculate expectation of uncertainty on sales, I use the standard deviation of natural logarithm of residuals from sales expectation model, and I label this measure as sales total risk (STR).

I use firm-level data from Compustat between 1994-2013. I use a regression model by replicating the SG&A cost asymmetry model documented in Anderson et al. (2003). The slope of interaction variable with sales revenue, decrease dummy of sales revenue, and SDR (STR) implies a managerial decision on the cost structure under sales downside risk (sales total risk). A positive slope indicates a short-run cost structure with low fixed costs and high variable costs, showing less sticky cost behavior and a negative slope indicates a short-run cost structure with high fixed costs and low variable costs, showing more stickier cost bahavior. Consistent with the hypothesis, managers decide to carry cost less sticky when they face sales downside risk and managers decided to carry cost stickier when they face sales total risk.

And I compare the effect of sales risks and earnings risks on managers' cost decision. I hypothesis that managers care more about sales risk than earnings risk when they decide in cost structure. To test this hypothesis, replicating Konchitchki et al. (2015), I constructed earnings downside risk from earnings expectation model and, I label such measure as earnings downside risk (EDR). And to calculate expectation of high uncertainty on earnings, I use standard deviation of natural logarithm of residuals from earnings expectation model, and I label such measure as earnings total risk (ETR). I examine the effect of EDR on manager's cost decision independently and also effect of both SDR and EDR on manager's cost decision. And I also examine the effect of ETR on manager's cost decision and the effect of both STR and ETR on cost decision. Consistent with hypothesis, manager care more about risk on sales than risk on earnings.

And lastly, in this paper, based on previous arguments, I examine whether different managerial ability has a different effect on a managerial decision on cost behavior under sales uncertainty. I expect that high ability manager understand the risk (both SDR and STD) better than low ability manager. So, high ability manager decides a cost structure more optimally than the low ability manager. The main measure of managerial ability (hereafter, the MA-Score) is developed in Demerjian et al. (2012). I expect a high ability manager is more knowledgeable of the expected future sales, and is more able to understand complex cost behavior than the low ability manager. Consistent with the hypothesis, manager with high ability better understand the risk on sales than a manager with low ability.

2. Hypothesis Development

Motivated by concepts of uncertainty from Banker et al. (2014), I used a different uncertainty measure from Banker et al. (2014) to see to what extent managers' decision has an effect on the degree of asymmetry cost behavior. I categorized the uncertainty into two types, downside risk, and total risk. The idea of measuring risk is influenced by Konchichki et al. (2015). They hypothesis that earnings downside risk captures the expectation for future downward operating performance and contains information about firms' risk and varies with the cost of capital of firms. First, I measure sales downside risk (labeled SDR) by following the similar method used to calculate earnings downside risk (labeled EDR). Stone (1973) and Fishburn (1977) theoretically employ risk framework of root lower partial moment. A measure of sales downside risk is defined relative to expected sales as the reference level, and given as follows:

$$\mathrm{SDR}_{it} = \log\frac{1+\mathrm{Lower}_2(\tau_{it})}{1+\mathrm{Upper}_2(\tau_{it})} = \log\left\{\frac{1+\left[\left(\frac{1}{N}\right)\sum_{\gamma_{it}<\tau_{it}}(\tau_{it}\text{-}\gamma_{it})^2\right]^{1/2}}{1+\left[\left(\frac{1}{N}\right)\sum_{\gamma_{it}\geq\tau_{it}}(\tau_{it}\text{-}\gamma_{it})^2\right]^{1/2}}\right\} \qquad (1)$$

where Lower and Upper are respectively the roots lower and upper partial moment. Konchitchki et al. (2015) add one to both numerators, and denominator to capture for possible effects caused by small values and use the logarithm for normalization. I estimate SDR for firm i on fiscal year-end t. The variable$_{it}$ refers to realized sales of firm i at fiscal year-end t, and it refers to the corresponding sales expectation and I estimate using the sales expectation model below.

I adopt the following sales expectation model to determine the expected level of sales:

$$SALES_{i,t} = \beta_0 + \beta_1 SALES_{i,t-1} + \beta_2 SG\&A_{i,t-1} + \beta_3 PP\&E_{,t-1} + \beta_4 SIZE_{,t-1} + \varepsilon_{i,t} \quad (2)$$

,where Sales is annual sales, and SG&A is Selling General & Administration cost, and PP&E is Property Plant & Equipment. In the sales expectation model, I include the t-1 year of sales followed by Banker and Chen (2006) and assume that increased in t-1year SG&A, PP&E and, SIZE will increase the sales next year. The fitted value of Eq. (2) represents expected sales, and the estimated residual, $\varepsilon_{i,t}$, indicates the deviations below ($\hat{\varepsilon}_{it} < 0$) or above equal to ($\hat{\varepsilon}_{it} \geq 0$) the expectation. Therefore, the EDR construction in Eq. (1) can be expressed as follows:

$$\log\left\{\frac{1+\left[\left(\frac{1}{N}\right)\sum(\hat{\varepsilon}_{it} \times I\hat{\varepsilon}_{it<0})^2\right]^{1/2}}{1+\left[\left(\frac{1}{N}\right)\sum(\hat{\varepsilon}_{it} \times I\hat{\varepsilon}_{it\geq 0})^2\right]^{1/2}}\right\} \quad (3)$$

where, $I\hat{\varepsilon}_{it} < 0$ is an indicator variable that equals one if $\hat{\varepsilon}_{it} < 0$, that is realized sales is below its expected level and zero otherwise; $I\hat{\varepsilon}_{it} \geq 0$ is an indicator equal to one if $\hat{\varepsilon}_{it} \geq 0$ and zero otherwise; and N is the total number of residuals.

To estimate the residuals of the sales expectation model in Eq. (2), I employ ordinary least square(OLS) regressions over 5-years and 8-years rolling windows, after winsorizing all variables at the 1st and 99th percentiles of sample distributions. Then I use the residuals to compute SDR according to Eq. (3). And to calculate STR, I use standard deviation of residuals over 5-years and 8-years rolling windows.

Banker, Byzalov, and Plehn-Dujowich (2014) argue both analytically and empirically that increase in demand uncertainty cause to increase optimal level of the fixed input, resulting in a more rigid short-run cost structure with high fixed costs and low variable costs. And also, they state that increased downside risk cause to decreased optimal level of the fixed input, resulting in less rigid short-run cost structure with low fixed costs and high variable costs. Following above logic and calculation of SDR and STR, I predict that degree of cost asymmetry will decrease when manager face downside risk of sales. On the contrary, I also predict that degree of cost asymmetry will increase when the manager faces total downside risk of sales.

Hypothesis 1a. The degree of cost asymmetry is negatively associated when the firm faces Sales downside risk.

Hypothesis 1b. The degree of cost asymmetry is positively associated when the firm faces Total sales risk.

I conjecture that when a manager decides cost structure based on revenue change, they care more about risk on sales revenue than risk on earnings. Therefore, I compare manager's reaction to SDR and EDR and see if the effect of SDR subsumes an effect of EDR. And also compare manager's reaction to STR and ETR and see if the effect of STR subsumes an effect of ETR. This leads to hypothesis 2.

Hypothesis 2. Managers would incorporate risk on sale rather than risk on earnings when they decide the structure of cost.

Manager with high ability have better understanding of cost structure and decide more optimal cost decision under uncertainty than the manager with low ability. Therefore, I predict high ability manager decide to carry cost less sticky under sales downside risk and to carry cost more stickier under sales total risk. On the other hand, low ability managers does not understand and does not incorporate both sales downside risk and total sales risk when they decide the cost structure. Therefore, above prediction leads to hypothesis 3.

Hypothesis 3. Managers with high ability better understand and incorporate the risk of sales than managers with low ability.

3. Sample and variable measurement

I obtain data on SG&A costs, sales revenue and another variable from the COMPUSTAT annual industrial files from 1994 to 2013. I follow procedure discussed in Anderson et al. (2003) and Anderson and Lanen (2007). I start with firm-year observations in the COMPUSTAT annual industrial files for fiscal years. I require sales and SG&A costs to be available in the current year and the previous year in the sample period, and I also require SG&A costs to be smaller than sales. Next, I delete the top and the bottom 1 percent of observations values of the change in SG&A costs and change in sales revenue. Finally, I follow Anderson and Lanen's 2007 and delete sample where SG&A increases following sales decreases or SG&A decreases following sales increases. This results in the sample of 76,372 observations.

4. Empirical results

Table 1 presents descriptive statistics on revenues, SG&A costs, SDR, STR, EDR, ETR, and other economic variables. On average, our sample firms have 2610 in annual sales revenue (median = 212.74) and 467.6 in SG&A costs (median = 44.28). The mean percentage of SG&A costs to sales revenue is 28.9 percent (median = 24.1 percent). On average, firms have 0.02 (median = 0.004) employees and 12.04 (mean = 1.39) of assets. The firm has not experienced two consecutive years of sales decreases (median = 0, mean = 0.199). And average GDP is 4.6% (median=4.9%). For risk variables, mean and median of SDR are -0.156 and -0.000, respectively, suggesting that the root lower partial moment of unexpected sales is smaller than the corresponding root higher partial moment. The standard deviation of SDR is 1.71, indicating high variance in downside risk. And mean and median of EDR are 0.0017 and 0, respectively, suggesting that the root lower partial moment of unexpected earnings is slightly larger than the corresponding root higher partial moment. The standard deviation of EDR is 0.177, indicating high variance in downside risk. Mean and median of STR are -1.9 and 2.4, indicating less variation of residuals. Mean and median of ETR are -8.06 and -3.88, indicating that volatile of unexpected earnings is lesser than that of unexpected sales.

Table 2 provides Spearman and Pearson correlations between our main variables. The majority of the correlations are significant but small in magnitude. Correlation between SDR and EDR is insignificant but very small in magnitude, indicating that SDR and EDR has different risk characteristics. Also, correlation between STR and ETR is not significant and value is very small, indicating STR and ETR has different risk characteristics.

(Table 1 & 2 here)

Table 3 presents results from estimating (i.e., residual) sales expectation model in Eq (2). The estimated residuals are used in the SDR construction according to Eq. (3) and Table 3 reports average estimated coefficients as well as average adjusted R squared for the regressions estimated by industry using 5-year rolling windows. The average estimated coefficient on lagged SALES, SG&A costs, PP&E, and SIZE are significantly positive. And the average adjusted R squared is 97.09%, indicating that most of future sales is explained.

(Table 3 here)

I estimate the following regression to replicate the SG&A cost asymmetry documented in previous studies:

$$
\begin{aligned}
log(SG\&A_{i,t}/SG\&A_{i,t-1}) = & \beta_0 + \beta_1 log(Rev_{i,t}/Rev_{i,t-1}) \\
& + \beta_2 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) \\
& + \boldsymbol{\beta_3 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * SDR_{i,t} (STR_{i,t})} \\
& + \beta_4 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * Successive\_Dummy_{i,t} \\
& + \beta_5 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * Growth_{i,t} \\
& + \beta_6 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * log(Asset_{i,t}/Rev_{i,t}) \\
& + \beta_7 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * log(Employees_{i,t}/Rev_{i,t}) \\
& + \beta_8 SDR_{i,t}(STR_{i,t}) + \varepsilon_{i,t} \qquad (4)
\end{aligned}
$$

where $SG\&A_{i,t}$ *and* $Revenue_{i,t}$ are selling, general and administrative costs and sales revenue, respectively, for firm i at year t, Decrease_Dummy takes the value of one when sales revenues of year t are less than those of year t-1 and zero otherwise. Coefficient β_1 measures the percentage increase in SG&A costs with a 1 percent increase in sales revenue. And there are four economic determinants as control variables: Employee Intensity, Asset Intensity, Successive Performance, GDP growth. Because the value of Decrease_Dummy is one when revenue decreases, the sum of the coefficients ($\beta_1 + \beta_2$) represent the percentage decrease in SG&A costs with 1 percent decrease in sales revenue. A significantly positive coefficient β_1 and a significantly negative coefficient β_2 would be consistent with cost asymmetry. To support cost asymmetry, β_1 in model (4) needs to be significantly positive and β_2 needs to be significantly negative.

(Table 4 here)

The results are shown in Table 4. The estimated value of β_1 is 0.52 (0.51) for the 5 year (8 year) rolling sample. This indicates that SG&A costs increase by about 0.52 percent (0.51 percent) per 1 per increase in sales revenue. The estimated value of β_2 is -0.25 (-0.29) for 5 year (8 year) rolling sample. The combined value of $\beta_1 + \beta_2$ =0.27 (0.22) per 1 percent decrease in sales revenue. These results show that SG&A cost asymmetry is robust.

The coefficient on the economic variable interaction terms is largely consistent with the prior literature. The significant negative coefficient on Asset Intensity (-0.19 and -0.21 for 5 years and 8year rolling sample, respectively) suggests that a higher degree of SG&A cost asymmetry in firms that need relatively more assets to support their activities. And also for the Employee Intensity, the coefficient is negative (-0.02 and -0.01), suggesting that a greater degree of SG&A cost asymmetry in firms that require relatively more employees to support operations. The coefficient on Successive Decrease is significantly positive (0.30 and 0.27), suggesting a lower degree of SG&A cost asymmetry in firms experiencing negative demand shocks in two consecutive years.

Hypothesis 1a and 1b predict that the sales downside risk (sales total risk) is negatively (positively) related with the degree of cost asymmetry after controlling for economic determinants. Thus, the coefficient for the interaction term can be expressed as a function of the SDR (STR), where SDR stands for sales downside risk, and STR stands for sales total risk. As the extent of cost asymmetry increases with the degree of the negative value of β_2, the extent of cost asymmetry increases with the degree of the positive (negative) value of β_3 and β_4.

(Table 5 here)

Hypothesis 1a predicts that the extent of SG&A cost asymmetry decreases with sales downside risk. A positive coefficient on the SDR interaction term would indicate a less degree of cost asymmetry, so I expect the coefficient on the SDR interaction term to be positive. As shown in columns 3 and 4 of Table 4, the result is consistent with Hypothesis 1a. The coefficient on the SDR interaction term is significantly positive at the 1 percent level both in 5 year and 8 year rolling regression (0.08 and 0.09 respectively), suggesting that SG&A cost asymmetry decrease when SDR is higher.

Hypothesis 1b predicts that the degree of SG&A cost asymmetry increases with STR. A negative coefficient on the STR Interaction term would indicate a greater degree of cost asymmetry, so I expect the coefficient on the STR interaction term to be negative. As shown in Table 4, the result is consistent with Hypothesis 1b. The coefficient on the STR interaction term is significantly negative at the 1 percent level (-0.009 and -0.006 respectively), indicating that SG&A cost asymmetry is greater when the manager faces high STR.

Hypothesis 2 predicts that the managers would incorporate risk on sale rather than risk on earnings when they decide cost structure. To test this hypothesis, first I constructed EDR and ETR, and substitute SDR with EDR and see if cost decision by managers is affected by downside risk on earnings. And also, I substitute STR with ETR and see if cost decision by managers is affected by total risk on earnings.

$$\begin{aligned} log(SG\&A_{i,t}/SG\&A_{i,t-1}) = \beta_0 + \beta_1 log(Rev_{i,t}/Rev_{i,t-1}) \\ + \beta_2 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) \\ + \boldsymbol{\beta_3 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * SDR_{i,t}} \\ + \boldsymbol{\beta_4 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * EDR_{i,t}} \\ + \beta_5 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * Successive\_Dummy_{i,t} \\ + \beta_6 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * Growth_{i,t} \\ + \beta_7 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * log(Asset_{i,t}/Rev_{i,t}) \\ + \beta_8 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * log(Employees_{i,t}/Rev_{i,t}) \\ + \beta_9 SDR_{i,t} + \beta_{10} EDR_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (5)$$

In column 3,4 of Table 5, I only include the EDR interaction term to only effect of EDR on asymmetry cost behavior. Similar to a prediction of hypothesis 1a and 1b, a positive coefficient on the EDR interaction term would indicate a less degree of cost asymmetry, so I expect the coefficient on the EDR interaction term to be positive. As shown in columns 3 and 4 of Table 5, the result is consistent with prediction similar to Hypothesis 1a. The coefficient on the EDR interaction term is significantly positive at the 1 percent level both in 5 years and 8 years rolling regression (0.05 and 0.09 respectively), suggesting that SG&A cost asymmetry decreases when EDR is higher. However, as shown in model (5), the inclusion of the SDR variable renders coefficient of EDR, β_4 , insignificant while the coefficient of SDR survives (0.03, 0.025) in column 5,6 of Table 5, suggesting that SDR variable subsume the effects of EDR. This implies that managers consider sales downside risk more significantly than earnings downside risk when they decide cost structure.

$$\begin{aligned} & log(SG\&A_{i,t}/SG\&A_{i,t-1}) = \beta_0 + \beta_1 log(Rev_{i,t}/Rev_{i,t-1}) \\ & + \beta_2 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) \\ & + \boldsymbol{\beta_3 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * STR_{i,t}} \\ & + \boldsymbol{\beta_4 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * ETR_{i,t}} \\ & + \beta_5 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * Successive\_Dummy_{i,t} \\ & + \beta_6 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * Growth_{i,t} \\ & + \beta_7 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * log(Asset_{i,t}/Rev_{i,t}) \\ & + \beta_8 Decrease\_Dummy_{i,t} * log(Rev_{i,t}/Rev_{i,t-1}) * log(Employees_{i,t}/Rev_{i,t}) \\ & + \beta_9 STR_{i,t} + \beta_{10} ETR_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{6}$$

(Table 6 Here)

In column 3,4 of Table 6, I only include the ETR interaction term to only effect of ETR on asymmetry cost behavior. A negative coefficient on the ETR Interaction term would indicate a greater degree of cost asymmetry, so I expect the coefficient on the ETR interaction term to be negative. As shown in Table 6, the result is consistent with prediction similar to Hypothesis 1b. The coefficient on the ETR interaction term is significantly negative at the 1 percent level (-0.018 and -0.029 respectively), indicating that SG&A cost asymmetry is greater when the manager faces high ETR. However, as shown in model (6), the inclusion of STR variable renders coefficient of ETR, β_4, insignificant while the coefficient of STR survives (-0.005, -0.006) in column 5,6 of Table 6. This also implies that managers consider sales total risk more significantly than earnings total risk when they decide cost structure.

(Table 7 Here)

Finally, to test Hypothesis 3, I divide the sample into two based on MA-score, low ability managers, and high ability managers. And for each sample, I use model (1) to see if there is different coefficient on SDR and STR. In table 7, column 3, coefficient β_2 becomes insignificant and also coefficient β_3 and β_4 become insignificant in a sample of low ability manager, implying that manager carries costs in proportional to change in sales revenue regardless of any situations. This would mean that managers with low ability does not fully aware or understand the risk they face. As a result, manager just mechanically adjust the cost in respect to sales revenue. However, in table 5, column 4, coefficient β_2 is significant and also coefficients of β_3 , β_4 are significant (0.05, -0.006) in sample of high ability manager, implying that manager understand the properties of different risks on sales, downside risk and total risk, and incorporate such risks into decision making on cost structure.

5. Additional Analysis

To test robustness of SDR and STR, I performed additional test adopted from Banker, Byzalov, Cifitci, and Mashruwala (2014) (hereafter, BBCM). BBCM refined the cost stickiness model by showing cost stickiness conditional on prior sales increase and anti-cost stickiness conditional on a prior sales decrease. I use model (7) to see effect of SDR on cost stickiness conditional on prior sales increase and effect of SDR on anti-cost stickiness conditional on a prior sales decrease.

$$\Delta\, log(SGA_{i,t}) = \beta_0 + I_{i,t-1}(\beta_1^{PIncr}\, \Delta\, log(Revenue_{i,t}) + \beta_2^{PIncr}\, D_{i,t} * \Delta\, log(Revenue_{i,t})$$
$$+ \delta_1^{PIncr}\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * SDR_{i,t})$$
$$+ D_{i,t-1}(\beta_1^{PDecr}\, \Delta\, log(Revenue_{i,t}) + \beta_2^{PDecr}\, D_{i,t} * \Delta\, log(Revenue_{i,t})$$
$$+ \delta_1^{PDecr}\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * SDR_{i,t})$$
$$+ \beta_3\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * Growth_{i,t}$$
$$+ \beta_4\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * log(Asset_{i,t}/Revenue_{i,t})$$
$$+ \beta_5\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * log(Employees_{i,t}/Revenue_{i,t}) + \varepsilon_{i,t} \qquad (7)$$

And also for STR, I use model (8) to see effect of STR on cost stickiness conditional on prior sales increase and effect of STR on anti-cost stickiness conditional on a prior sales decrease.

$$\Delta\, log(SGA_{i,t}) = \beta_0 + I_{i,t-1}(\beta_1^{PIncr}\, \Delta\, log(Revenue_{i,t}) + \beta_2^{PIncr}\, D_{i,t} * \Delta\, log(Revenue_{i,t})$$
$$+ \delta_1^{PIncr}\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * STR_{i,t})$$
$$+ D_{i,t-1}(\beta_1^{PDecr}\, \Delta\, log(Revenue_{i,t}) + \beta_2^{PDecr}\, D_{i,t} * \Delta\, log(Revenue_{i,t})$$
$$+ \delta_1^{PDecr}\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * STR_{i,t})$$
$$+ \beta_3\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * Growth_{i,t}$$
$$+ \beta_4\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * log(Asset_{i,t}/Revenue_{i,t})$$
$$+ \beta_5\, D_{i,t} * \Delta\, log(Revenue_{i,t}) * log(Employees_{i,t}/Revenue_{i,t}) + \varepsilon_{i,t} \qquad (8)$$

(Table 8 Here)

Table 8, column 3 shows significant effect of SDR on cost stickiness following a prior sales increase (δ_1^{PIncr}=0.046) and significant effect of SDR on anti-cost stickiness following prior sales decrease (δ_1^{PDecr}=0.048). This result shows that managers consider sales downside risk as an meaningful signal in additional to prior sales change when they decide the level of the cost activities. And Table 8, column 4 shows significant effect of STR on cost stickiness following a prior sales increase (δ_1^{PIncr}=-0.00199) and significant effect of STR on anti-cost stickiness following prior sales decrease (δ_1^{PDecr}=-0.00361).

5. Conclusion

Understanding the behavior of cost is important in managerial accounting. And how manager make cost decision could be crucial in operating the firm. This paper is about findings of managers' cost decisions under uncertainty and whether manager understands risk on sales and incorporate such risk into cost decisions. Based on this logic, first I construct a sales prediction model and measure a sales downside risk and see how manager react differently to sales downside risk. I find that (1) managers hold less of fixed costs relative to variable costs when they face sales downside risk, resulting less sticky cost and (2) hold more of fixed costs when they face sales overall risk resulting more sticky cost. And managers (3) care more of risk on sales than risk on earnings when they make cost decisions. And (4) managers with more ability could better capture such risk. This study confirms the findings from previous studies that uncertainty affects managers' cost decisions, and extend the findings to cost stickiness. And this paper suggests that sales risk is more important than earnings risk in cost decision, and managerial ability plays a role in dealing with uncertainty.

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TABLE 1

Descriptive Statistics

Measure	N	Mean	Median	Q1	Q3	Std. dev.
Sales revenue	76,372	2610	212.74	47.26	986.9	13134.55
SG&A costs	76,372	467.6	44.28	11.77	178.7	2095
SG&A as % of Revenue	76,372	28.9	24.10	13.3	39.03	20.6
Employee Intensity	76,372	0.02	0.004	0.002	0.008	0.62
Asset Intensity	76,372	12.04	1.39	0.75	3.93	339
Successive Decrease (Indicator)	76,372	0.199	0	0	0	0.39
SDR	76,372	-0.156	-0.000	-0.36	0.17	1.71
STR	76,372	-1.9	2.4	-0.17	4.27	11.3
EDR	76,372	0.0017	0	-0.007	0.008	0.177
ETR	76,372	-8.06	-3.88	-5.77	-2.58	11.05
Growth	76,372	4.6	4.9	3.7	6.3	1.98

TABLE 2

Correlations

	$\Delta\ log(SGA_{i,t})$	$\Delta log(Rev)_{i,t}$	$EDR_{i,t}$	$SDR_{i,t}$	$ETR_{i,t}$	$STR_{i,t}$
$\Delta\ log(SGA_{i,t})$	1.000	0.481	−0.011	−0.055	0.025	−0.033
$\Delta log(Rev)_{i,t}$	0.466	1.000	−0.076	−0.059	0.031	−0.024
$EDR_{i,t}$	−0.04	−0.039	1.000	0.029	−0.200	0.0067
$SDR_{i,t}$	−0.143	−0.097	0.091	1.000	0.0037	−0.063
$ETR_{i,t}$	0.06	0.007	−0.326	0.0053	1.000	−0.0001
$STR_{i,t}$	−0.044	−0.061	0.0034	−0.049	−0.0002	1.000

TABLE 3

Results from estimating sales expectation model

$$Sales_{i,t+1} = \beta_0 + \beta_1 Sales_{i,t} + \beta_2 SG\&A_{i,t} + \beta_3 PP\&E_{i,t} + \beta_4 Size_{i,t} + \varepsilon_{i,t}$$

Variable	Pred.	Coefficient	T-Stat	
$Sales_{i,t}$	+	1.01	871.03	***
$SG\&A_{i,t}$	+	0.01	2.18	**
$PP\&E_{i,t}$	+	0.04	36.01	***
$Size_{i,t}$	+	14.6	11.63	***
Number of Observation	76,372			
Adjusted R^2	97.09%			

*,**,*** Indicate significance at p<0.1, p<0.05, p<0.01 respectively

TABLE 4

Regressing annual changes in SG&A costs on annual changes in sales revenue and Sales downside risk and Sales Total Risk

Dependent variable:		$log(SG\&A_{i,t}/SG\&A_{i,t-1})$							
		5 years rolling		8 years rolling		5 years rolling		8 years rolling	
Independent variable	Pred.	(1)		(2)		(3)		(4)	
Intercept		0.06	***	0.09	***	0.03	***	0.03	***
		(64.22)		(66.33)		(51.16)		(49.12)	
$log(Rev_{i,t}/Rev_{i,t-1})$	+	0.52	***	0.51	***	0.54	***	0.59	***
		(144.15)		(139.12)		(121.36)		(119.33)	
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})$	−	−0.25	***	−0.29	**	−0.21	**	−0.18	***
		(−2.98)		(−2.34)		(−2.14)		(−3.11)	
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*SDR$	+	0.08	***	0.09	***				
		(4.55)		(6.64)					
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*STR$	−					−0.009	***	−0.006	***
						(−4.28)		(−3.41)	
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*Succ\_D_{i,t}$	+	0.30	***	0.27	***	0.28	***	0.23	***
		(19.77)		(29.37)		(33.24)		(35.12)	
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*Growth_{i,t}$	−	−0.02	***	−0.01	**	−0.04	**	−0.02	**
		(−3.11)		(−1.95)		(−2.22)		(−2.12)	
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*log(Asset_{i,t}/Rev_{i,t})$	−	−0.19	***	−0.21	***	−0.06	***	−0.05	***
		(−13.20)		(−24.31)		(−13.43)		(−15.44)	
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*log(Emp_{i,t}/Rev_{i,t})$	−	−0.02	*	−0.01	*	−0.09		−0.01	**
		(−1.93)		(−1.81)		(−1.44)		(−2.32)	
SDR		−0.0038	***	−0.0021	***				
		(−8.34)		(−9.1)					
STD						0.00014	**	0.0019	**
						(2.21)		(1.96)	
Number of observations		76,372		76,372		76,372		76,372	
Adjusted R^2		45.27%		49.12%		50.16%		51.33%	

*,**,*** Indicate significance at p<0.1, p<0.05, p<0.01 respectively

TABLE 5

Regressing annual changes in SG&A costs on annual changes in sales revenue and Sales Downside Risk and Earnings Downside Risk

Dependent variable:		$log(SG\&A_{i,t}/SG\&A_{i,t-1})$			
		5 years rolling	8 years rolling	5 years rolling	8 years rolling
Independent variable	Pred.	(1)	(2)	(3)	(4)
Intercept		0.06 ***	0.10 ***	0.06 ***	0.04 ***
		(59.26)	(88.22)	(33.12)	(38.13)
$log(Rev_{i,t}/Rev_{i,t-1})$	+	0.47 ***	0.49 ***	0.45 ***	0.51 ***
		(180.13)	(177.31)	(155.4)	(113.2)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})$	−	−0.21 ***	−0.18 ***	−0.13 **	−0.16 ***
		(−4.99)	(−4.66)	(−2.10)	(−2.96)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*SDR$	+			0.03 **	0.025 **
				(1.99)	(2.11)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*EDR$	+	0.05 ***	0.09 ***	0.04	0.06
		(5.12)	(3.51)	(1.52)	(1.39)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*Succ\_D_{i,t}$	+	0.31 ***	0.35 ***	0.26 ***	0.27 ***
		(18.1)	(23.8)	(15.51)	(16.31)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*Growth_{i,t}$	−	−0.014 ***	−0.015 **	−0.022 **	−0.031 ***
		(−2.99)	(−2.13)	(−2.01)	(−2.91)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1}*log(Asset_{i,t}/Rev_{i,t})$	−	−0.21 ***	−0.18 **	−0.19 **	−0.14 **
		(−3.14)	(−2.05)	(−2.27)	(−1.99)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1}*log(Emp_{i,t}/Rev_{i,t})$	−	−0.08 ***	−0.05 ***	−0.04	0.08 **
		(−2.72)	(−3.08)	(−1.89)	(−1.99)
SDR				−0.0001 ***	−0.00024 ***
				(−9.31)	(−5.48)
EDR		0.0001 **	0.013 **	0.0031 **	0.0015
		(2.01)	(1.99)	(1.97)	(1.45)
Number of observations		76,372	76,372	76,372	76,372
Adjusted R^2		53.17%	50.15%	49.91%	58.39%

*,**,*** Indicate significance at p<0.1, p<0.05, p<0.01 respectively

TABLE 6

Regressing annual changes in SG&A costs on annual changes in sales revenue and Sales Total Risk and Earnings Total Risk

Dependent variable:		$log(SG\&A_{i,t}/SG\&A_{i,t-1})$			
		5 years rolling	8 years rolling	5 years rolling	8 years rolling
Independent variable	Pred.	(1)	(2)	(3)	(4)
Intercept		0.11 ***	0.08 ***	0.05 ***	0.04 ***
		(44.31)	(56.6)	(66.82)	(34.31)
$log(Rev_{i,t}/Rev_{i,t-1})$	+	0.59 ***	0.51 ***	0.52 ***	0.55 ***
		(91.34)	(100.8)	(77.3)	(90.1)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})$	−	−0.29 ***	−0.20 **	−0.24 ***	−0.23 ***
		(−5.88)	(−3.12)	(−5.37)	(−4.91)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*STR$	−			−0.005 **	−0.006 **
				(−1.99)	(−2.00)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*ETR$	−	− 0.018 ***	−0.029 ***	−0.012	−0.019
		(−3.94)	(−4.13)	(−1.02)	(−1.51)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*$ $Succ\_D_{i,t}$	+	0.29 ***	0.23 ***	0.31 ***	0.33 ***
		(15.21)	(16.3)	(19.00)	(18.21)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*$ $Growth_{i,t}$	−	−0.021 ***	−0.034 ***	−0.088 **	−0.011 ***
		(−2.56)	(−2.77)	(−2.13)	(−2.91)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*$ $log(Asset_{i,t}/Rev_{i,t})$	−	−0.28 *	−0.39 **	−0.30 **	−0.29 **
		(−1.88)	(−1.98)	(−2.13)	(−2.09)
$D_{i,t}*log(Rev_{i,t}/Rev_{i,t-1})*$ $log(Emp_{i,t}/Rev_{i,t})$	−	−0.04 ***	−0.08 **	−0.031 *	−0.061 **
		(−3.91)	(−2.83)	(−2.46)	(−2.99)
STR				−0.00003 ***	−0.000019 ***
				(−7.81)	(−8.47)
ETR		0.0055 **	0.0013 **	0.0001 **	0.0004 ***
		(1.99)	(2.01)	(2.17)	(2.66)
Number of observations		76,372	76,372	76,372	76,372
Adjusted R^2		55.14%	48.88%	61.20%	57.47%

*,**,*** Indicate significance at p<0.1, p<0.05, p<0.01 respectively

TABLE 7

Regressing annual changes in SG&A costs on annual changes in sales revenue and Sales downside risk and Sales total risk (for high ability manager vs. low ability manager)

Dependent variable :		$log(SG\&A_{i,t}/SG\&A_{i,t-1})$			
		Low Ability		High Ability	
Independent variables:	Pred.	(1)		(2)	
Intercept		0.073	***	0.15	***
		(44.33)		(51.91)	
$log(Rev_{i,t}/Rev_{i,t-1})$	+	0.49	***	0.56	***
		(75.06)		(119.55)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{,t-1})$	–	-0.11		-0.20	***
		(-0.84)		(-4.11)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{i,t-1})*SDR$	+	0.07		0.05	**
		(1.77)		(2.12)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{i,t-1})*STR$	–	-0.003		-0.006	**
		(-1.10)		(-2.09)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{i,t-1})* Succ\_D_{i,t}$	+	0.33	***	0.23	***
		(16.07)		(22.56)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{i,t-1})* Growth_{i,t}$	–	-0.05	***	-0.07	**
		(-3.44)		(-2.00)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{i,t-1})* log(Asset_{i,t}/Rev_{i,t})$	–	-0.17	***	-0.20	***
		(-13.97)		(-11.24)	
$Dec\_D_{i,t} * log(Rev_{i,t}/Rev_{i,t-1})* log(Employees_{i,t}/Rev_{i,t})$	–	-0.029	***	-0.031	***
		(-2.93)		(-2.77)	
SDR		-0.019		-0.090	**
		(-1.91)		(-1.99)	
STR		-0.0008	**	-0.0002	***
		(-2.04)		(-2.65)	
Number of observations		76,372		76,372	
Adjusted R^2		43.36%		43.02%	

*,**,*** Indicate significance at p<0.1, p<0.05, p<0.01 respectively

TABLE 8

Estimates for the Two-period model

Dependent variable :		$\Delta\ log(SGA_{i,t})$	
		SDR	STR
Independent variables:	Pred.	(1)	(2)
Intercept		0.026 ***	0.39 ***
		(23.43)	(32.63)
$I_{i,t-1}\beta_1^{PIncr}\ \Delta\ log(Revenue_{i,t})$	+	0.62 ***	0.46 ***
		(141.68)	(112.65)
$I_{i,t-1}\beta_2^{PIncr}\ D_{i,t} * \Delta\ log(Revenue_{i,t})$	–	−0.33 ***	−0.18 ***
		(−7.56)	(−9.36)
$I_{i,t-1}\delta_1^{PIncr}\ D_{i,t} * \Delta\ log(Revenue_{i,t})*SDR_{i,t}$	+	0.46 **	
		(2.09)	
$I_{i,t-1}\delta_1^{PIncr}\ D_{i,t} * \Delta\ log(Revenue_{i,t})*STR_{i,t}$	–		−0.0019 **
			(−2.12)
$D_{i,t-1}\beta_1^{PDecr}\ \Delta\ log(Revenue_{i,t})$	+	0.33 ***	0.21 ***
		(56.36)	(47.34)
$D_{i,t-1}\beta_2^{PDecr}\ D_{i,t} * \Delta\ log(Revenue_{i,t})$	–	0.19 ***	0.16 ***
		(4.48)	(8.35)
$D_{i,t-1}\delta_1^{PDecr}\ D_{i,t} * \Delta\ log(Revenue_{i,t})*SDR_{i,t}$	–	0.048 *	
		(1.72)	
$D_{i,t-1}\delta_1^{PDecr}\ D_{i,t} * \Delta\ log(Revenue_{i,t})*STR_{i,t}$	–		−0.00361 ***
			(−3.86)
$\beta_3\ D_{i,t} * \Delta\ log(Revenue_{i,t}) *\ Growth_{i,t}$		−0.036 ***	−0.015 ***
		(−9.65)	(−7.94)
$\beta_4\ D_{i,t} * \Delta\ log(Revenue_{i,t})*log(Asset_{i,t}/Revt_{i,t})$		−0.17 ***	−0.068 ***
		(−23.76)	(−22.42)
$\beta_5\ D_{i,t} * \Delta\ log(Revenue_{i,t})*log(Emp_{i,t}/Revt_{i,t})$		−0.055 ***	−0.04 ***
		(−7.99)	(−13.97)
Number of observations		76,372	76,372
Adjusted R^2		39.17%	36.71%

*,**,*** Indicate significance at p<0.1, p<0.05, p<0.01 respectively

국문초록

매출 하방위험이 원가하방경직성에 미치는 영향

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관리회계에서 원가의 특성을 이해하는 것은 중요하다. 이 연구에서는 불확실한 위험하에서 경영자들이 어떻게 원가 결정을 하는지에 대해서 알아보았다. 특히 경영자들이 매출에 대한 위험을 이해하는지 그리고 그 위험을 원가 의사결정에 반영하는지를 확인하였다. 이 논문에서는 매출 기대모형에서 측정한 매출 하방위험과 매출 전체위험이 원가경직성에 어떻게 그리고 얼마나 영향을 주는지에 관해 보았고 결과는 다음과 같다. (1) 매출 하방위험하에서 경영자들은 상대적으로 고정원가를 낮게 가져가며 이는 원가 하방경직성을 완화시키는 결과를 가져온다. (2) 매출 전체위험하에서 경영자들은 상대적으로 고정원가를 높게 가져가며 이는 원가 하방경직성을 강화시키는 결과를 가져온다. (3) 경영자들은 원가 의사결정시 이익 하방위험에 비해 매출 하방위험에 더 크게 반응하며 이익 전체위험에 비해 매출 전체위험에도 더 크게 반응한다. (4) 경영자의 능력에 따라 매출의 위험을 이해하는 정도가 달라지며 그 위험을 원가에 반영하는 정도에서 차이가 난다.

주요어 : 원가하방경직성, 매출하방위험, 매출전체위험, 이익하방위험, 이익전체위험, 경영자 능력
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