Are Selling, General, and Administrative Costs "Sticky"?

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ABSTRACT

A fundamental assumption in cost accounting is that the relation between costs and volume is symmetric for volume increases and decreases. In this study, we investigate whether costs are "sticky"—that is, whether costs increase more when activity rises than they decrease when activity falls by an equivalent amount. We find, for 7,629 firms over 20 years, that selling, general, and administrative (SG&A) costs increase on average 0.55% per 1% increase in sales but decrease only 0.35% per 1% decrease in sales. Our analysis compares the traditional model of cost behavior in which costs move proportionately with changes in activity with an alternative model in which sticky costs occur because managers deliberately adjust the resources committed to activities. We test hypotheses about the properties of sticky costs and how the degree of stickiness of SG&A costs varies with firm circumstances.

1. Introduction

Understanding cost behavior is an essential element of cost and management accounting. In the traditional model of cost behavior that pervades the accounting literature, costs are described as fixed or variable with respect to changes in activity volume. In this model, variable costs change

proportionately with changes in the activity driver (Noreen [1991]), implying that the magnitude of a change in costs depends only on the extent of a change in the level of activity, not on the direction of the change. But some allege costs rise more with increases in activity volume than they fall with decreases (Cooper and Kaplan [1998, p. 247], Noreen and Soderstrom [1997]). We label this type of cost behavior "sticky." Specifically, costs are sticky if the magnitude of the increase in costs associated with an increase in volume is greater than the magnitude of the decrease in costs associated with an equivalent decrease in volume.

Empirical research provides very little evidence about the behavior of activity costs in relation to changes in activity levels.[1] One reason for this paucity of research may be a perceived scarcity of broad-based data that include the costs and relevant drivers. However, data on selling, general, and administrative (SG&A) costs and sales revenue are widely available for a broad set of firms in the Compustat database. The behavior of SG&A costs can be meaningfully studied in relation to revenue activity because sales volume drives many of the components of SG&A (Cooper and Kaplan [1998, p. 341]).[2] In its annual SG&A survey, *CFO Magazine* performs extensive analyses of SG&A costs in relation to sales revenue (Mintz [1999]).

SG&A costs made up 26.4% of sales revenue for our broad-based sample of 7,629 firms over a 20-year period. We test for sticky cost behavior by estimating an empirical model that relates changes in SG&A costs to contemporaneous changes in net sales revenue. The model includes an interaction dummy variable that distinguishes between revenue-decreasing and revenue-increasing periods. We document that the percentage increase in SG&A costs for an increase in sales revenue is larger than the percentage decrease in SG&A costs for an equivalent decrease in sales revenue. For our pooled sample of Compustat firms from 1979 to 1998, SG&A costs increased 0.55% per 1% increase in revenue but fell only 0.35% per 1% decrease in revenue. Our observation of sticky cost behavior is robust to alternative estimation procedures including firm-specific time-series estimations, random coefficient regressions, and simultaneous equations models that accommodate potential endogeneity of SG&A costs and sales revenue.

The prevalence of sticky costs is consistent with an alternative model of cost behavior in which managers deliberately adjust resources in response to changes in volume. This model distinguishes between costs that move mechanistically with changes in volume and costs that are determined by the resources committed by managers. When there is uncertainty about future demand and firms must incur adjustment costs to reduce or restore committed resources, managers may purposely delay reductions to

[1] To the best of our knowledge, the only exceptions in the accounting literature are the study of airline costs by Banker and Johnston [1993] and the recent studies of hospital costs by Noreen and Soderstrom [1994, 1997] and Balakrishnan, Petersen, and Soderstrom [1999].

[2] We use sales revenue as an imperfect proxy for sales volume because sales volume is not directly observable.

committed resources until they are more certain about the permanence of a decline in demand. This suggests that stickiness observed in one period may reverse in a subsequent period and that stickiness may be less pronounced when the observation period is longer. We provide support for this alternative model by documenting reversal of period t stickiness in period $t + 1$ and reduction of stickiness with the aggregation of measurement periods.

When volume falls, managers must decide whether to maintain committed resources and bear the costs of operating with unutilized capacity or reduce committed resources and incur the adjustment costs of retrenching and, if volume is restored, replacing committed resources at a later date. This suggests that stickiness would be stronger in circumstances where the assessed probability that a demand decline is permanent is lower or where the costs of adjusting committed resources are higher. We estimate an expanded version of the sticky costs model and find empirical support for these economic arguments.

2. Stickiness of SG&A Costs

The traditional model of cost behavior relates costs to different levels of activity without considering how managerial intervention affects the resource-adjustment process. Managers make discrete changes to committed resources because some costs are lumpy; that is, committed resources cannot be added or subtracted in sufficiently small increments or quickly enough to match resource changes to small changes in demand. By itself, cost lumpiness may lead to excess or insufficient capacity but it does not lead to sticky costs. Sticky costs occur because there are asymmetric frictions in making resource adjustments—forces acting to restrain or slow the downward adjustment process more than the upward adjustment process.

Firms must incur adjustment costs to remove committed resources and to replace those resources if demand is restored. Adjustment costs include such things as severance pay when employees are dismissed and search and training costs when new employees are hired. In addition to out-of-pocket costs, adjustment costs include organizational costs such as loss of morale among remaining employees when associates are terminated or erosion of human capital when work teams are disrupted.

When demand increases, managers increase committed resources to the extent necessary to accommodate additional sales. When volume falls, however, some committed resources will not be utilized unless managers make the deliberate decision to remove them. Because demand is stochastic, managers must evaluate the likelihood that a drop in demand is temporary when deciding whether to adjust committed resources downward. Stickiness of SG&A costs occurs if managers decide to retain unutilized resources rather than incur adjustment costs when volume declines.

Managers' decisions to maintain unutilized resources may also be caused by personal considerations and result in a form of agency costs. Agency

costs are costs incurred by the firm because self-interested managers make decisions that maximize their personal utility but are not optimal from the perspective of the firm's stockholders (Jensen and Meckling [1976]). Managers may retain unutilized resources to avoid personal consequences of retrenchment, such as loss of status when a division is downsized or the anguish of dismissing familiar employees, contributing to sticky cost behavior.

We test for sticky cost behavior by comparing the variation of SG&A costs with sales revenue in periods when revenue increases with the variation of SG&A costs with sales revenue in periods when revenue decreases.

> *H1:* The relative magnitude of an increase in SG&A costs for an increase in sales revenue is greater than the relative magnitude of a decrease in SG&A costs for a decrease in sales revenue.

2.1 PROPERTIES OF STICKY COSTS

Changes in sales revenue may reflect short-term market conditions or long-term shifts in market demand for products and services. Managers facing a downturn in sales may wait to obtain information that enables them to assess the permanence of the demand reduction before making decisions to cut resources. Such delay leads to sticky costs because unutilized resources are maintained during the interim between the reduction in volume and the adjustment decision. There may also be a time lag between the decision to reduce committed resources and the realization of the change in costs because it takes time to unwind contractual commitments. An implication of delayed decision-making and contracting lags is that stickiness observed in one period may be reversed (offset by reductions to committed resources) in subsequent periods.

> *H2a:* Stickiness of SG&A costs reverses in subsequent periods.

Observation of stickiness in a single period reflects the costs of retaining unutilized resources in a period when a decline in revenue has occurred. When the observation window is expanded to include multiple periods, more complete adjustment cycles are captured. Over longer adjustment intervals, managers' assessments of the permanence of a change in revenue demand become surer and adjustment costs become smaller relative to the cost of retaining unutilized resources. Therefore, stickiness of costs is likely to be less pronounced when observed over greater aggregations of periods.

> *H2b:* Stickiness of SG&A costs declines with the aggregation of periods.

2.2 VARIATION IN THE DEGREE OF STICKINESS

Our analysis of sticky costs suggests that managers trade off the anticipated costs of carrying unutilized resources during periods of weak demand against the expected adjustment costs of retrenching and then ramping up if demand is restored. The lower the expected adjustment costs relative to

the costs of carrying unutilized resources, the more managers will reduce committed resources, resulting in less stickiness. Expected adjustment costs are determined by managers' assessments of the uncertainty of upward and downward movements in demand and their estimates of the costs of removing and then replacing committed resources. Expected adjustment costs decrease as managers' assessments of the permanence of revenue declines get stronger and increase with managers' estimates of the costs of scaling back and then scaling up again.

Based on these arguments, we make two sets of hypotheses about how the degree of stickiness of SG&A costs varies across firms and over time. First, we consider how the degree of stickiness would vary across situations that produce different expectations about the permanence of a decline in revenue activity (hypotheses 3a and 3b). Then, we consider how the degree of stickiness would vary with factors that indicate circumstances where the adjustment costs are likely to be higher (hypotheses 4a and 4b).

Because demand fluctuates with product market and economywide conditions, information about upward or downward trends in specific or general factors affecting demand accumulates as the trends develop. Managers' assessments of the permanence of a demand reduction are likely to get stronger as a revenue decline continues. Therefore, managers are likely to consider a revenue decline to be more permanent when it occurs in a second consecutive period of revenue losses. Increased likelihood of a permanent decline may motivate managers to scale down resources, resulting in less stickiness. Accordingly, we hypothesize that less stickiness occurs in periods when revenue also declined in the preceding period.

> *H3a:* Stickiness of SG&A costs is less pronounced when revenue also declined in the preceding period.

Managers evaluating the permanence of declines in demand in their specific product markets look to broader measures of economic activity for information that is useful in assessing the factors contributing to the decline. A decline in demand is more likely to persist in periods of economic contraction than in periods of economic growth. Therefore, managers would be less willing to reduce committed resources in periods of macroeconomic growth than in other periods, resulting in more stickiness. Also, shortages of labor in periods of economic growth increase the cost of replacing retrenched employees, reinforcing this stickiness.

> *H3b:* SG&A costs exhibit greater stickiness during periods of macroeconomic growth.

Adjustment costs are likely to be higher when SG&A activities rely more on assets owned and people employed by a company than materials and services purchased by the company. Unless long-term contracts exist, it is relatively easy to scale down purchased resources when demand drops, but disposing of assets is costly because the company must pay selling costs and lose firm-specific investments (installation and customization costs).

Restructuring charges recognized when a firm downsizes typically involve large write-downs of fixed assets (Stickney and Brown [1999, pp. 219–22]).

H4a: The degree of stickiness increases with the asset intensity (ratio of total assets to sales revenue) of the company.

Similarly, the costs of adjusting committed resources are likely to be higher for firms that use more employees to support a given volume of sales. Dismissing employees is costly because employers must pay severance costs. Restructuring charges usually include large amounts for severance payments. Employers also lose investments made in firm-specific training if employees are released when demand falls and new employees must be hired when demand picks up again. In addition, companies experience productivity losses because morale declines when employees are laid off, and they may experience more turnover because employee loyalty is eroded.

H4b: The degree of stickiness increases with the employee intensity (ratio of number of employees to sales revenue) of the company.

3. Empirical Tests of Stickiness of SG&A Costs

An empirical model that enables measurement of the SG&A response to contemporaneous changes in sales revenue and discriminates between periods when revenue increases and revenue decreases is presented. The interaction variable, *Decrease_Dummy*, takes the value of 1 when sales revenue decreases between periods $t-1$ and t, and 0 otherwise.
Model (I):

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right]$$
$$+ \beta_2 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \varepsilon_{i,t}.$$

This model provides the basis for our test of stickiness of SG&A costs.[3] Because the estimation is cross-sectional with a wide variety of industries and large differences in the size of firms, the ratio form and log specification improves the comparability of the variables across firms and alleviates potential heteroskedasticity. Empirically, the Davidson and MacKinnon [1981] test rejects the linear form in favor of this loglinear model. Results are qualitatively similar to those presented for all our models when we estimate them with linear specifications.

The log specification also accommodates economic interpretation of the estimated coefficients. Because the value of *Decrease_Dummy* is 0 when revenue increases, the coefficient β_1 measures the percentage increase in SG&A costs with a 1% increase in sales revenue. Because the value of

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[3] If the traditional fixed- and variable-cost model is valid, upward and downward changes in costs will be equal and consequently $\beta_2 = 0$. Furthermore, if fixed costs are present, $\beta_1 < 1$, signifying economies of scale.

Decrease_Dummy is 1 when revenue decreases, the sum of the coefficients, $\beta_1 + \beta_2$ measures the percentage increase in SG&A costs with a 1% decrease in sales revenue. If SG&A costs are sticky, the variation of SG&A costs with revenue increases should be greater than the variation for revenue decreases. Thus, the empirical hypothesis for stickiness, conditional on $\beta_1 > 0$ is $\beta_2 < 0$.[4]

3.1 DESCRIPTION OF DATA

The primary variables used in our analysis are SG&A costs (annual Compustat #189) and net sales revenue (annual Compustat #12). The data set includes annual data for industrial firms covering the 20 years from 1979 to 1998. Data were drawn for all firms included in the PST (primary, supplementary, and tertiary) and full-coverage files of Compustat 1999. We screened the data for missing observations of either SG&A costs or sales revenue in the current or preceding year and deleted observations if SG&A costs exceeded sales revenue. The total number of remaining observations is 64,663 for 7,629 firms, an average of about 8.5 observations per firm.

Panel A of table 1 provides descriptive information about annual revenues and SG&A costs for the complete 20-year sample. The mean value of SG&A costs as a percentage of sales revenue is 26.41% (median = 22.62%, standard deviation = 17.79%). Panel B of table 1 provides information about the frequency of firm-periods when revenue fell (relative to the previous period) and firm-periods when SG&A costs fell. Revenue fell in 27.01% of the annual firm-periods in the sample and SG&A costs fell in 24.98% of the firm-periods. The mean value of revenue decreases is 17.45% (median value = 10.99%, standard deviation = 18.64%) and the mean value of decreases in SG&A costs is 15.67% (median value = 10.07%, standard deviation = 16.40%).

3.2 ESTIMATION RESULTS

We estimated the model using ordinary least squares (OLS). We eliminated extreme observations from the estimation by excluding an observation if the value of any variable was in the top or bottom 0.5% of its distribution (Chen and Dixon [1972]), resulting in a reduction of 705 observations to 63,958 observations. White's [1980] test indicated that heteroskedasticity was not a problem for our loglinear model. We applied the Belsley, Kuh, and Welsch [1980] diagnostic to test for multicollinearity in the pooled estimation. None of the condition indexes exceeded 5, well below the suggested cutoffs. We evaluated serial correlation in the data on a firm-by-firm basis. The Durbin-Watson [1951] test statistic revealed significant (at the 5% level) positive autocorrelation for less than 3% of the firms, indicating that it was not necessary to correct for serial correlation in the data.

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[4] Noreen and Soderstrom [1997] specify a similar model and conduct a test for asymmetric cost behavior with respect to activity increases and decreases. Using data for hospital overhead costs, their results provided weak evidence of asymmetric behavior (negative signs on their interaction term for activity decreases for 12 of 16 accounts, but overall not significantly different from zero).

TABLE 1

Summary Statistics

All the reported numbers are in millions of dollars. The distribution of sales revenue and SG&A costs is for a population of 64,663 firm-year observations from 7,629 firms in the 1999 Compustat data set that satisfy the following selection criteria: no missing observations of sales revenue (annual Compustat item #12) for the current and preceding year, no missing observations of SG&A costs (item #189) for the current and preceding year, and no firm-years in which SG&A costs exceeded sales revenue. In panel B, observations with a negative change in sales revenue form the basis for the reported numbers in the first row and observations with a negative change in SG&A costs form the basis for the reported numbers in the second row.

Panel A: Distribution of Annual Revenue and SG&A Costs from 1979 to 1998

	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile
Sales revenue	$1277.09	$5983.43	$87.53	$17.51	$447.75
Selling, general, and administrative (SG&A) costs	$229.45	$1042.49	$17.49	$4.56	$79.12
SG&A costs as a percentage of revenue	26.41%	17.79%	22.62%	13.66%	34.31%

Panel B: Periodic Fluctuations in Revenue and SG&A Costs from 1979 to 1998

	Percentage of Firm-Years with Negative Percentage Change from Previous Period	Mean Percentage Decrease Across Periods	Standard Deviation of Percentage Decreases Across Periods	Median Percentage Decrease Across Periods	Upper Quartile of Percentage Decreases Across Periods	Lower Quartile of Percentage Decreases Across Periods
Sales revenue	27.01%	17.45%	18.64%	10.99%	23.76%	4.38%
SG&A costs	24.98%	15.67%	16.40%	10.07%	21.63%	3.94%

We present the results of estimating model (I) for the pooled sample in table 2. The results were similar when we estimated a fixed-effects model. We initially estimated the model with changes in SG&A costs and sales revenue defined for one-year periods. The estimated value of $\hat{\beta}_1$ of 0.5459 (t-statistic $= 164.11$) indicates that SG&A costs increased 0.55% per 1% increase in sales revenues. The estimated value of $\hat{\beta}_2 = -0.1914$ (t-statistic $= -26.14$) provides strong support for the sticky costs hypothesis. The combined value of $\hat{\beta}_1 + \hat{\beta}_2 = 0.3545$ indicates that SG&A costs decreased only 0.35% per 1% decrease in sales revenue. The fact that $\hat{\beta}_1$ and $\hat{\beta}_1 + \hat{\beta}_2$ are both significantly less than one (p-values $= 0.001$) indicates that SG&A costs were not proportional to changes in revenue, even though this cost driver is apparently strong.[5] For comparative purposes, we also estimated a model

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[5] Noreen and Soderstrom [1994] find that overhead costs at hospitals in Washington State were not proportional to activity. In a related study, Noreen and Soderstrom [1997] find that the average variation of overhead was about 20% of the variation in the activity driver. They suggest that the low percentage may reflect maintenance of specific capacities by hospitals.

TABLE 2

Results of Regressing Changes in SG&A on Changes in Sales Revenue for the 20-Year Period 1979–98

Regression specification for model (I):

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right]$$

$$+ \beta_2 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \varepsilon_{i,t}$$

Regression specification for model (II):

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \beta_2 Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right]$$

$$+ \beta_3 \log\left[\frac{Revenue_{i,t-1}}{Revenue_{i,t-2}}\right] + \beta_4 Decrease\_Dummy_{i,t-1} * \log\left[\frac{Revenue_{i,t-1}}{Revenue_{i,t-2}}\right] + \varepsilon_{i,t}$$

Decrease_Dummy$_{i,t}$ takes a value of 1 when revenue of firm i for period t is less than that in the preceding period.

	Coefficient Estimates (t-statistics)				
	Model (I) One-Year Periods	Model (II) One-Year Periods	Model (I) Two-Year Periods	Model (I) Three-Year Periods	Model (I) Four-Year Periods
$\hat{\beta}_0$	0.0481	0.0333	0.0574	0.0603	0.0783
	(39.88)	(25.90)	(25.12)	(16.31)	(16.67)
$\hat{\beta}_1$	0.5459	0.5328	0.6816	0.7148	0.7427
	(164.11)	(130.43)	(141.91)	(104.71)	(97.00)
$\hat{\beta}_2$	−0.1914	−0.1876	−0.1569	−0.0919	−0.0343
	(−26.14)	(−23.47)	(−13.40)	(−5.56)	(−1.76)
$\hat{\beta}_3$		0.1038			
		(29.79)			
$\hat{\beta}_4$		0.1042			
		(13.23)			
Adjusted R^2	0.3663	0.3893	0.5349	0.5933	0.6513
Number of observations	63,958	56,420	26,052	12,398	8,565

without the interaction variable for revenue decreasing periods. The coefficient $\hat{\beta}_1$ estimated for this limited model is 0.4909, representing the variation of SG&A costs with revenue changes that would be measured if no allowance were made for asymmetry in the change in costs with revenue increases and revenue decreases.

3.3 LAGGED EFFECTS AND AGGREGATION OF PERIODS

To test hypothesis 2a—that stickiness is reversed in subsequent periods—we extended model (I) by including terms for one-period lagged changes to sales revenue.

Model (II):

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \beta_2 Decrease\_Dummy_{i,t}$$

$$* \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \beta_3 \log\left[\frac{Revenue_{i,t-1}}{Revenue_{i,t-2}}\right]$$

$$+ \beta_4 Decrease\_Dummy_{i,t-1} * \log\left[\frac{Revenue_{i,t-1}}{Revenue_{i,t-2}}\right] + \varepsilon_{i,t}.$$

Results of estimating this empirical specification are presented alongside the results for model (I) in table 2. The significant and positive coefficient $\hat{\beta}_1$ of 0.5328 (t-statistic $= 130.43$) is similar to its counterpart in the model (I) estimation (table 2), as is the significant and negative coefficient $\hat{\beta}_2$ of -0.1876 (t-statistic $= -23.47$), supporting contemporaneous stickiness. The significant and positive coefficient $\hat{\beta}_3$ of 0.1038 (t-statistic $= 29.79$) indicates a lagged adjustment to SG&A for changes in sales revenue. The estimated coefficient $\hat{\beta}_4$ of 0.1042 is also significant and positive (t-statistic $= 13.23$), indicating a partial reversal of stickiness in the period after a revenue decline ($\hat{\beta}_4 < |\hat{\beta}_2|$, t-statistic $= 9.09$). These results support the hypothesis that managers delay decisions to make reductions to committed resources.

The remaining columns in table 2 present the results of estimating model (I) for two-, three-, and four-year aggregation periods (changes in SG&A costs and sales revenue are defined for adjacent two-, three-, and four-year periods). These results show that $\hat{\beta}_2$ decreases as the aggregation period increases (test of equality of $\hat{\beta}_2$ for each pair of aggregation periods is rejected at the 5% significance level), indicating that stickiness diminishes with the length of the aggregation period, consistent with hypothesis 2b.

We also estimated model (I) on a year-by-year basis for the 20 years of data and found that the estimated coefficients are robust over time. For the year-by-year estimations, the mean value of $\hat{\beta}_1$ is 0.5261 (standard deviation $=$ 0.1015) and the mean value of $\hat{\beta}_2$ is -0.1591 (standard deviation $= 0.1589$). The first and third quartiles are 0.4947 and 0.5748 for $\hat{\beta}_1$ and -0.2727 and -0.0264 for $\hat{\beta}_2$. The aggregated z-statistics of 112.07 for $\hat{\beta}_1$ and -15.41 for $\hat{\beta}_2$ support the sticky costs hypothesis.

3.4 TIME-SERIES MODELS

The sticky costs hypothesis may be interpreted as a time-series hypothesis for individual firms. To test the hypothesis on a firm-by-firm basis, we estimated individual time-series models for 2,081 firms that had at least 10 valid observations and three or more reductions in sales revenue during the sample period. Because the sticky costs hypothesis is conditional on $\hat{\beta}_1 > 0$, we excluded 214 firms with negative values of $\hat{\beta}_1$. We also trimmed 50 firms with extreme values of the coefficients in their time-series regressions, leaving 1,817 firms. We aggregated the t-statistics from the firm-specific time-series regressions, as in Dechow, Huson, and Sloan [1994] and Lambert and

TABLE 3

Results of Estimating Time-Series Regressions of Annual Changes in SG&A on Annual Changes in Sales Revenue for Individual Firms from 1979 to 1998

$$\log\left[\frac{SG\&A_t}{SG\&A_{t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_t}{Revenue_{t-1}}\right] + \beta_2 * Decrease\_Dummy_t * \log\left[\frac{Revenue_t}{Revenue_{t-1}}\right] + \varepsilon_t$$

Decrease_Dummy$_t$ takes the value of 1 when revenue in period t is less than revenue in $t-1$, 0 otherwise. Firms are included in the analysis if they have at least 10 valid observations during the sample period and at least 3 of those with reductions in the activity level (as measured by sales revenue) in the current year compared with the previous year. Of the total number of firms, 2,081 satisfied this criterion; 214 firms were excluded because the estimated value of β_1 from a firm-specific OLS regression was negative and 50 firms were excluded because they had extreme values of estimated coefficients (top and bottom 0.5% of the distribution of the estimated values) in firm-specific OLS regressions. The final sample consisted of 1,817 firms. In the random coefficients model, $\beta_{1i} = \bar{\beta}_1 + \tilde{\beta}_{1\varepsilon}$; $\beta_{2i} = \bar{\beta}_2 + \tilde{\beta}_{2\varepsilon}$; $\tilde{\beta}_{1\varepsilon}$ and $\tilde{\beta}_{2\varepsilon}$ are distributed bivariate normally with mean 0.

	Coefficient Estimates			
	Firm-by-Firm Estimation		Random Coefficients Estimation	
	Mean of the Estimated Firm-Specific Parameters (aggregated z-statistic)	Standard Deviation of the Cross-Sectional Distribution of the Firm-Specific Parameters	Mean of the Estimated Firm-Specific Parameters (t-statistic)	Standard Deviation of the Cross-Sectional Distribution of the Firm-Specific Parameters
$\hat{\beta}_1$	0.7156	0.3756	0.6717	0.2300
	(139.82)		(76.36)	
$\hat{\beta}_2$	−0.2403	0.8615	−0.1405	0.2934
	(−14.48)		(−9.46)	

Larcker [1987]. We report the results in table 3. The mean $\hat{\beta}_1$ obtained from these regressions is 0.7156 (aggregate z-statistic = 139.82) and the mean $\hat{\beta}_2$ is −0.2403 (aggregate z-statistic = −14.48), supporting the sticky costs hypothesis. The z-statistics require the assumption of cross-sectional independence (i.e., $\bar{r} = 0$). To check the validity of the cross-sectional independence assumption, we randomly selected 100 firms with complete time series of data from our sample firms and estimated the pairwise correlation between the regression residuals. The mean correlation is only 0.0289, indicating that cross-sectional dependence is not a serious concern in our data.

When there is cross-sectional variation in the coefficients, an alternative and more direct approach (to aggregation of individual time-series regressions) is to estimate a single random coefficients model (Green [1997, p. 669]). We estimated a random coefficients model under the assumption that the coefficients β_1 and β_2 are normally distributed across firms. We report the results of estimating this model for the 1,817 firms in table 3, as well. The mean $\hat{\beta}_1$ obtained from these estimations is 0.6717 (t-statistic = 76.36) and the mean $\hat{\beta}_2$ is −0.1405 (t-statistic = −9.46), supporting the sticky costs hypothesis.

3.5 OTHER ROBUSTNESS TESTS

To provide assurance that the results were not systematically affected by inflation, we converted all SG&A and revenue amounts to equivalent 1984 dollars and reestimated model (I) for the pooled sample with the inflation-adjusted amounts. The results, $\hat{\beta}_1 = 0.5466$ (t-statistic $= 160.92$) and $\hat{\beta}_2 = -0.1721$ (t-statistic $= -24.18$), are similar to those reported for model (I). One of the components of SG&A expense is foreign currency translation adjustments (annual Compustat #150). Because these adjustments introduce noise into the measure of SG&A, we removed them from the SG&A data and estimated model (I) again. Results of this estimation, $\hat{\beta}_1 = 0.5983$ (t-statistic $= 85.81$) and $\hat{\beta}_2 = -0.2077$ (t-statistic $= -13.84$), are also similar to those reported for the initial estimation.

It may be argued that there are two-way relations between SG&A costs and sales revenue. Expenditures on SG&A costs, such as marketing costs, affect sales volume whereas sales volume affects SG&A costs. To address this potential simultaneity, we estimated a simultaneous equations model that included changes in SG&A expenditures and sales revenue as endogenous variables. In the first equation of this model, the change in SG&A costs is expressed as a function of the change in sales revenue. In the second equation, the change in sales revenue is expressed as a function of the change in SG&A costs. Lagged variables are included in both equations to ensure identification of the system. The results of estimating this model, $\hat{\beta}_1 = 0.4671$ (t-statistic $= 11.49$) and $\hat{\beta}_2 = -0.2207$ (t-statistic $= -4.93$), support the sticky costs hypothesis and the reversal of stickiness in subsequent periods ($\hat{\beta}_4 = 0.0839$, t-statistic $= 3.54$). The coefficients on the contemporaneous and lagged changes in SG&A costs in the second equation are significantly positive, $\hat{\gamma}_1 = 1.5285$ (t-statistic $= 131.53$) and $\hat{\gamma}_2 = 0.2284$ (t-statistic $= 18.27$), suggesting SG&A costs positively influence sales.

Advertising is a specific discretionary expenditure included with SG&A costs that influences the level of revenue activity. For firms that reported advertising costs separately, we estimated a model that related changes in non-advertising SG&A costs to changes in revenue in one equation and changes in revenue to changes in advertising costs in a second equation. Results of estimating this model support the sticky costs hypothesis, $\hat{\beta}_1 = 0.6298 > 0$ (t-statistic $= 68.77$) and $\hat{\beta}_2 = -0.1232 < 0$ (t-statistic $= -6.56$), and the reversal of stickiness in subsequent periods ($\hat{\beta}_4 = 0.1142$, t-statistic $= 6.11$). Significant and positive coefficients on the contemporaneous and lagged advertising change terms, $\hat{\gamma}_1 = 0.2214$ (t-statistic $= 51.69$) and $\hat{\gamma}_2 = 0.1007$ (t-statistic $= 24.05$) support the effect advertising has on current and future sales.

4. *Variation in the Degree of Stickiness*

Hypotheses 3a through 4b describe conditions and circumstances that would affect the degree of stickiness across firms and over time under the

alternative model of cost behavior. The coefficient on the sticky costs term, β_2 in model (I), may be expanded to include the various economic factors described in hypotheses 3a through 4b as follows:

$$\beta_2 = \gamma_0 + \gamma_1 * Successive\_Decrease_{i,t} + \gamma_2 * Growth_{i,t} + \gamma_3 * \log\left[\frac{Assets_{i,t}}{Revenue_{i,t}}\right]$$

$$+ \gamma_4 * \log\left[\frac{Employees_{i,t}}{Revenue_{i,t}}\right].$$

The $Successive\_Decrease_{i,t}$ dummy is activated for firm-year observations when revenue declined in the preceding period. The $Growth_{i,t}$ variable is the percentage growth in real gross national product (GNP) during year t. Substituting this relation into model (I) gives:

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \left\{\gamma_0 + \gamma_1 * Successive\_Decrease_{i,t}\right.$$

$$+ \gamma_2 * Growth_{i,t} + \gamma_3 * \log\left[\frac{Assets_{i,t}}{Revenue_{i,t}}\right]$$

$$\left.+ \gamma_4 * \log\left[\frac{Employees_{i,t}}{Revenue_{i,t}}\right]\right\} * Decrease\_Dummy_{i,t}$$

$$* \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \varepsilon_{i,t}.$$

This is restated as model (III), where $\beta_k = \gamma_{k-2}$ in the expanded version of model (I), $k = 2, 3, 4, 5,$ and 6.

Model (III):

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right]$$

$$= \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \beta_2 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right]$$

$$+ \beta_3 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * Successive\_Decrease_{i,t}$$

$$+ \beta_4 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * Growth_{i,t}$$

$$+ \beta_5 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * \log\left[\frac{Assets_{i,t}}{Revenue_{i,t}}\right]$$

$$+ \beta_6 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * \log\left[\frac{Employees_{i,t}}{Revenue_{i,t}}\right] + \varepsilon_{i,t}.$$

The $Decrease\_Dummy_{i,t}$ variable is included in the last five terms in model (III), meaning that these terms are activated for all periods when

T A B L E 4

Results of Regressing Annual Changes in SG&A Costs on Annual Changes in Sales Revenue and Determinants of Sticky Cost

Regression specification:

$$\log\left[\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right] = \beta_0 + \beta_1 \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] + \beta_2 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right]$$

$$+ \beta_3 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * Successive\_Decrease_{i,t}$$

$$+ \beta_4 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * Growth_{i,t}$$

$$+ \beta_5 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * \log\left[\frac{Assets_{i,t}}{Revenue_{i,t}}\right]$$

$$+ \beta_6 * Decrease\_Dummy_{i,t} * \log\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right] * \log\left[\frac{Employees_{i,t}}{Revenue_{i,t}}\right] + \varepsilon_{i,t}$$

Decrease_Dummy takes the value of 1 when revenue in period t is less than revenue in $t-1$, 0 otherwise. *Successive_Decrease* takes the value of 1 when revenue in period $t-1$ is less than revenue in $t-2$, 0 otherwise. *Growth* is the percentage growth in real GNP during year t. The reported t-statistics are based on White's hetroskedasticity-corrected standard errors. The random coefficients model is estimated as described in table 3.

		Coefficient Estimates	
	Predicted Sign	Pooled Estimation (t-statistic)	Random Coefficients Estimation (t-statistic)
β_0		0.0546	0.0209
		(27.01)	(13.23)
β_1	+	0.5444	0.6699
		(56.44)	(74.58)
β_2	−	−0.2245	−0.2514
		(−2.63)	(−5.59)
β_3	+	0.2415	0.2227
		(8.30)	(15.66)
β_4	−	−0.0179	−0.0070
		(−1.83)	(−1.78)
β_5	−	−0.1496	−0.0975
		(−11.38)	(−12.69)
β_6	−	−0.0338	−0.0143
		(−2.04)	(−1.71)
Adjusted R^2		0.4103	

revenue declined. As in model (I), where the degree of stickiness increases with the magnitude of the negative value of $\hat{\beta}_2$, the degree of stickiness increases (decreases) with the magnitude of negative (positive) coefficients $\hat{\beta}_2$ through $\hat{\beta}_6$ in model (III).

The results of estimating model (III) are presented in table 4. The estimated coefficient $\hat{\beta}_1 = 0.5444$ is significant and positive (t-statistic $= 56.44$) and of similar magnitude as its value in the model (I) estimation of the pooled sample. The significant and positive coefficient $\hat{\beta}_3 = 0.2415$

(t-statistic $= 8.30$) indicates that the degree of stickiness is lower in revenue-declining periods that were preceded by revenue-declining periods, consistent with hypothesis 3a that managers would consider a reduction in demand that occurred in successive years to be more permanent. The significant and negative coefficient $\hat{\beta}_4 = -0.0179$ (t-statistic $= -1.83$) indicates that the degree of stickiness is greater in higher growth periods, consistent with the argument underlying hypothesis 3b that managers would consider revenue declines that occur in a strong economic climate to be more transitory than revenue declines in a weak economy.

The significant and negative coefficients $\hat{\beta}_5 = -0.1496$ (t-statistic $= -11.38$) on the term that includes asset intensity (assets to sales revenue) and $\hat{\beta}_6 = -0.0338$ (t-statistic $= -2.04$) on the term that includes employee intensity (employees to sales revenue) indicate that costs were stickier at firms that required relatively more employees or more assets to support their sales. These results are consistent with the rationale underlying hypotheses 4a and 4b that stickiness increases with the adjustment costs that would be incurred to reduce committed resources.

We also estimated a random coefficients regression for model (III). Results of estimating this random coefficients model also support hypothesis 3a that stickiness is less pronounced in a second successive year of revenue decline ($\hat{\beta}_3 = 0.2227$, t-statistic $= 15.66$), hypothesis 3b that stickiness is greater in years of macroeconomic growth ($\hat{\beta}_4 = -0.0070$, t-statistic $= -1.78$), hypothesis 4a that stickiness is greater for firms that use relatively more assets to support their sales ($\hat{\beta}_5 = -0.0975$, t-statistic $= -12.69$), and hypothesis 4b that stickiness is greater for firms that employ relatively more people to support their sales ($\hat{\beta}_6 = -0.0143$, t-statistic $= -1.71$).

5. Conclusion

Our evidence documents, in a broad sense, the prevalence of sticky cost behavior for SG&A costs. In contrast to the commonly received model of fixed and variable costs, our results are consistent with an alternative model of cost behavior that recognizes the role of managers in adjusting committed resources in response to changes in activity-based demand for those resources. The results of this study have important implications for accountants and other professionals who evaluate cost changes in relation to changes in revenues.

Textbook treatments of cost behavior recommend methods such as regression analysis to estimate the average amount of the change in costs associated with a unit change in the activity driver (e.g., Hilton [1997, pp. 312–15], Horngren, Foster, and Datar [1999, pp. 338–39]). Making such estimations without considering sticky costs leads to underestimation of the responsiveness of costs to increases in activity and overestimation of the responsiveness of costs to decreases in activity. Similarly, instructions for flexible budgeting indicate that budgeted costs should be flexed symmetrically for both positive and negative differences between the actual and

initial budget quantity (e.g., Hilton [1997, pp. 526–30], Horngren, Foster, and Datar [1999, pp. 222–24]). Such methods are likely to cause distortions in managerial decisions based on cost analyses.

A managerial implication of our analysis is that sticky costs can be recognized and controlled. Managers can evaluate their exposure to sticky costs by considering the sensitivity of cost changes to reductions in volume. They may increase the sensitivity of costs to changes in volume by making contracting decisions that reduce the adjustment costs associated with changing the levels of committed resources. For example, managers may make it easier to adjust the supply of resources by using temporary employees or outsourcing functions whose demand for resources varies considerably with volume.

Our study also has implications for financial analysts and auditors. A common procedure in financial statement analysis involves comparison of SG&A expense items as a percentage of net sales across firms within an industry or over time for a specific firm (White, Sondhi, and Fried [1997, p. 148]). Analysts interpret a disproportionate increase in selling expenses as a negative signal because it may represent a loss of managerial control or an unusual sales effort (Bernstein and Wild [1998, p. 583], Mintz [1999]). This analysis may be misleading because the underlying assumption that selling expenses move proportionately with sales is not empirically valid when the data include both sales increases and decreases. Similarly, auditors implicitly assume that costs should move proportionately with sales when performing analytical review procedures (Messier [2000, p. 545]). Analytical procedures may be improved by a better understanding of how SG&A costs change with revenues.

The empirical models employed in this study provide a platform for further research on the causes and consequences of sticky cost behavior. Although the use of Compustat data enabled documentation of the prevalence of sticky cost behavior for a large cross-section of firms, it did not permit finer disaggregation of the SG&A costs. Future research using finer data may provide information on cost behavior for different components of SG&A costs as well as other types of costs. Evidence was also provided that sticky cost behavior is consistent with deliberate decision making by managers who weigh the economic consequences of their actions. Developing a greater understanding of the managerial decision-making processes and the forces that lead to sticky cost behavior will be an important step in improving cost analysis.

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