

The Moderating Effect of Prior Sales Changes on Asymmetric Cost Behavior (14-019)

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The Moderating Effect of Prior Sales Changes on Asymmetric Cost Behavior

ABSTRACT

Recent research documents the empirical phenomenon of “sticky costs” and attributes it to a theory of deliberate managerial decisions in the presence of adjustment costs. We refine this theoretical explanation and show that it gives rise to a more complex pattern of asymmetric cost behavior that combines two opposing processes: cost stickiness conditional on a prior sales increase and cost anti-stickiness conditional on a prior sales decrease. These predictions reflect the structure of optimal decisions with adjustment costs and the impact of prior sales changes on managers’ expectations about future sales changes. Empirical estimates for Compustat data support our hypotheses. We further verify our predictions using additional proxies for managers’ expectations, and show that our model offers important new insights.

JEL Classifications: D24, M41

Keywords: optimism, pessimism, cost stickiness, anti-stickiness, cost behavior

INTRODUCTION

Recent research documents that many costs are “sticky”—they decline less in response to sales decreases than they rise for equivalent sales increases (Anderson, Banker and Janakiraman 2003, hereafter ABJ). These findings are inconsistent with the traditional model of fixed and variable costs, and suggest an alternative theory of cost behavior that is based on deliberate managerial decisions. ABJ argue that when sales decrease, managers choose to retain slack resources to avoid resource adjustment costs such as severance payments to dismissed workers and disposal losses on equipment. By contrast, when demand increases beyond available resource capacity, managers can meet the demand only if they add the required resources. This asymmetry in resource adjustment leads to cost stickiness. Following ABJ, numerous studies have documented sticky costs in various contexts (e.g., Weiss 2010; Chen et al. 2012; Dierynck et al. 2012; Kama and Weiss 2013), and ABJ’s theory of cost stickiness has become dominant in research on cost behavior and its implications.

In this paper, we refine the theory and empirical models of sticky costs. We show that ABJ’s intuition of managerial discretion and resource adjustment costs gives rise to a more complex fundamental pattern of cost asymmetry, which goes beyond ABJ’s predictions of asymmetry on average and combines two conditional processes: cost stickiness conditional on a prior sales increase and cost *anti-stickiness* conditional on a prior sales decrease.¹ This prediction reflects two effects of prior period sales change. First, following a prior sales increase (decrease), managers’ expectations for future sales are more optimistic (pessimistic). Optimism increases managers’ willingness to acquire additional resources when current sales increase and to retain unused resources when current sales decrease; pessimism has the opposite effect. Second, in the

¹ Costs are said to be “anti-sticky” if they decrease more when sales fall than they increase when sales rise equally (Weiss 2010).

prior period, managers retained significant slack resources only if sales decreased in that period. Therefore, the amount of slack carried over into the current period is smaller in the case of a prior sales increase than in the case of a prior sales decrease. As we show in the next section, these two effects lead to cost stickiness in the current period only in the case of a prior sales increase, and they generate the opposite predictions of anti-stickiness following a prior sales decrease.

We leverage this theoretical argument to develop a new empirical model of asymmetric cost behavior. Similar to the standard ABJ model, we estimate a piecewise-linear relation between log-changes in sales and concurrent log-changes in costs, and interpret the degree of asymmetry in this relation as a measure of cost stickiness or anti-stickiness. However, unlike the standard model, we condition this piecewise-linear relation on the direction of *prior* period sales change. In other words, we estimate two sets of parameters, interacted with dummy variables for prior sales increases and decreases, respectively. Because the structure of this two-period model is directly guided by the theory, it captures the fundamental process of asymmetric cost behavior.

We estimate the model for multiple cost categories in Compustat data, including SG&A costs, COGS and the number of employees, along with more detailed components of SG&A costs such as R&D expense and advertising expense. As expected, for all cost categories we observe significant cost stickiness only following a prior sales increase, and we find the opposite pattern of significant anti-stickiness in the case of a prior sales decrease. These results support our predictions. We also examine additional signals that managers likely rely on to assess future sales, including order backlog (Rajgopal et al. 2003), macroeconomic growth (Lev and Thiagarajan 1993), and other information captured in analysts' sales forecasts. As expected, when these signals point to greater optimism, we observe stronger stickiness conditional on a

prior sales increase and weaker anti-stickiness conditional on a prior sales decrease. These results further underscore the importance of managerial expectations in asymmetric cost behavior. Additionally, whereas the ABJ model allows for deliberate managerial decisions only for sales decreases and assumes mechanistic resource expansion when sales are increasing, we show that managerial discretion and expectations are equally important in the context of sales increases.

Ours is not the first study to document deviations from cost stickiness. The term “anti-stickiness” was coined by Weiss (2010), who provided the first broad-based evidence of this empirical phenomenon. Using a new firm-level measure of cost asymmetry, Weiss found that costs are anti-sticky in 43 percent of his Compustat sample. However, the goal of his analysis was to examine the impact of asymmetric cost behavior on analysts’ forecast accuracy and coverage. In other words, he used the firm-level asymmetry measure as an explanatory variable, treating the observed degree of asymmetry as given. Consequently, he did not focus on explaining or predicting the occurrence of anti-stickiness. In contrast, our analysis identifies the theoretical and empirical drivers of both cost stickiness and cost anti-stickiness. Thus, while Weiss (2010) has shown that costs are *sometimes* anti-sticky, we establish *when* they are likely to be anti-sticky. This contributes to better understanding and better prediction of cost behavior and, by extension, of earnings behavior.²

Our findings support ABJ’s fundamental insight that asymmetric cost behavior reflects deliberate resource commitment decisions by managers. However, our results also reveal that the understanding of when sticky costs arise should be revised significantly. We demonstrate that adjustment costs and managerial expectations lead to a systematic reversal in the direction of

² The advantage of Weiss’s approach is that it provides a firm-level measure of cost asymmetry. However, because this measure can be computed only for firms that had both a recent sales increase and a recent sales decrease, it entails substantial data loss. Therefore, our two-period model and its extensions are more appropriate when the objective is to examine the drivers of asymmetric cost behavior or to predict future costs or earnings.

asymmetry, a new insight into the structure of asymmetric cost behavior. We further show that cost response to sales increases is not mechanistic, and is affected by the same factors. These results both extend and refine the paradigm of sticky cost behavior in accounting research. Our two-period model incorporates these insights and offers a new empirical tool for future studies, including financial accounting research that requires understanding or predicting cost behavior because earnings are directly affected by costs.

In the next section, we develop the theory and formulate the hypotheses. In subsequent sections, we describe the data and the estimation models, and present the empirical results. The final section concludes.

THEORY AND HYPOTHESIS DEVELOPMENT

The Theory of Asymmetric Cost Behavior

The traditional model of fixed and variable costs envisions a mechanistic symmetric relation between sales (or another cost driver³) and concurrent costs. However, ABJ show that SG&A costs behave asymmetrically, contrary to the traditional model, falling less in response to sales decreases than they rise for equivalent sales increases (i.e., SG&A costs are “sticky”). Subsequent research has demonstrated that cost stickiness is pervasive across different cost categories and datasets, and has explored the implications of sticky costs for both financial and cost accounting (e.g., Banker and Chen 2006; Weiss 2010; Chen et al. 2012; Dierynck et al. 2012; Kama and Weiss 2013). Most of these studies rely on ABJ’s theory of sticky costs, establishing it as the standard explanation for asymmetric cost behavior.

ABJ’s explanation for sticky costs builds on two key insights. First, many costs arise because of deliberate resource commitment decisions by managers. Second, changing committed

³ Following ABJ, we use sales as our activity measure.

resource levels is costly—it entails incurring resource adjustment costs, such as hiring and firing costs for labor resources, or installation and disposal costs for equipment. ABJ argue that when sales decrease, managers prefer to retain some slack resources rather than incur adjustment costs to fully dispose of such resources (and adjustment costs to add back resources if sales rebound in a subsequent period). Therefore, costs will reflect resource requirements *plus* retained slack, and will decline less than proportionately to the sales decrease. By contrast, when demand rises sufficiently, managers can fully accommodate the demand *only if* they acquire additional resources.⁴ Because managers will not acquire unneeded resources, costs will be determined by concurrent resource requirements conditional on realized sales, and will rise proportionately to the sales increase.⁵ ABJ maintain that this asymmetry in managerial decisions is the source of cost stickiness.

Although ABJ’s explanation is empirically accurate on average, it is incomplete. In particular, retention of slack resources has an additional effect—it reduces the extent of resource expansion that will be needed when sales rebound later on. Therefore, we revise the theoretical explanation in several ways. First, we show that ABJ’s retained slack argument produces new predictions for cost asymmetry *conditional* on the direction of prior period sales change; these predictions are driven by previously retained slack and arise even if managers’ expectations remain unchanged. Second, we consider the role of managerial expectations for future sales. Further, we allow managerial discretion not only for sales decreases, as in ABJ, but also for sales increases.

⁴ If managers choose not to expand committed resources fully commensurate to the demand increase (which may be optimal if resource expansion is sufficiently costly), then realized sales will be limited by resource capacity, and the observed sales increase will be smaller than the (unobserved) demand increase.

⁵ Indivisible resources, which can be adjusted only in discrete steps, may rise less than proportionately or more than proportionately in response to a given sales change, depending on the distance to the nearest step. However, because managers cannot accommodate a sales increase with insufficient indivisible resources, but can respond to a sales decrease by retaining unused resource units, the asymmetry on average in resource adjustment is likely to be qualitatively similar to that for divisible resources.

We first refine ABJ's retained slack argument, showing that the type of asymmetry (stickiness or anti-stickiness) observed in the current period is determined by the direction of *prior* period sales change. If sales increased in the prior period $t-1$ (relative to period $t-2$), then managers only acquired needed resources in that period, and the amount of slack carried over into the current period t is close to zero. Given negligible initial slack, if sales rise further in the current period, managers will need to expand committed resources proportionately. If sales fall in the current period, however, managers will be able to retain additional slack (up to the maximum acceptable level⁶), cutting resources less than proportionately. Thus, conditional on a prior period sales increase, costs in current period t are likely to be sticky, consistent with the standard predictions in the literature. We depict this scenario in panel A of Figure 1.

[Insert Figure 1 here]

However, the predictions are reversed in the case of a prior sales decrease. If sales decreased in period $t-1$, then managers retained significant slack resources in that period, which were then carried over into the current period t . If sales increase in the current period, managers will use up the available slack before adding new resources, and will therefore expand resources less than proportionately. By contrast, if sales decrease further in the current period, managers will have to cut resources proportionately, or almost proportionately, to avoid exceeding the maximum acceptable level of slack.⁷ Therefore, costs will rise less for current sales increases than they will

⁶ Because managers take into account the cost of excessive resources, they will tolerate only a limited amount of slack. Formally, managers will cut resources as long as the present value of net cash flows from the marginal resource unit (including expected future adjustment costs that would be caused or saved by this unit) is lower than the negative of downward adjustment costs, in which case it is more efficient to incur the adjustment costs than to keep this marginal unit (Bentolila and Bertola 1990). As we show later, managers' willingness to retain slack is higher when they are optimistic than when they are pessimistic.

⁷ If the prior sales decrease was sufficiently large such that managers retained maximum acceptable slack, then they will cut resources proportionately to the current sales decrease. However, if the prior sales decrease was relatively small such that retained slack was below the maximum acceptable level, then managers will retain additional slack in the current period and will cut resources less than proportionately.

fall for current sales decreases, exhibiting cost *anti-stickiness*.⁸ We present this scenario in panel B of Figure 1.

Prior sales change direction also affects managers' expectations for future sales, another key determinant of cost asymmetry. Managers are likely to be more optimistic (pessimistic) following a prior sales increase (decrease), for two reasons. First, sales changes are positively correlated over time.⁹ Therefore, a prior period sales increase indicates a greater likelihood of further increases, corresponding to more optimistic expectations about future sales. Conversely, a prior sales decrease points to a higher probability of further decreases, corresponding to greater pessimism. Notably, this interpretation of managerial "optimism" and "pessimism" reflects managers' best inferences about future sales based on relevant economic information, which can be favorable or unfavorable. This holds even in the absence of psychological biases. Second, studies in behavioral economics suggest that managers extrapolate past trends (Barberis et al. 1998; Daniel et al. 1998; Lant and Hurley 1999). Therefore, following a prior sales increase or decrease, managers will anticipate further sales changes in the same direction. Thus, the impact of prior sales change direction on managers' expectations can reflect both rational statistical inferences and behavioral biases. Because both of these mechanisms imply greater optimism (pessimism) following a prior sales increase (decrease), our predictions are robust to both interpretations.

⁸ Balakrishnan et al. (2004) develop a related argument that costs are likely to be anti-sticky when *current* capacity utilization is low. However, our analysis, which is conditioned on prior period sales change rather than current capacity utilization, offers several improvements. First, current capacity utilization is affected by current resource adjustments, which can lead to spurious estimates of the impact of capacity utilization. *Prior* period slack (or prior period capacity utilization) is a much more appropriate factor to consider as a determinant of managers' resource adjustment decisions. Second, while these authors view capacity utilization as given, we recognize that capacity utilization is an endogenous outcome of managerial decisions that were made in response to prior sales changes. Third, prior sales increases and decreases affect managers' expectations for future sales, a mechanism that is not included in Balakrishnan et al.'s analysis.

⁹ For example, serial correlation of log-changes in sales in our Compustat sample is 0.230, significant at the 1 percent level. The probability of a current period sales increase is 71.2 percent following a prior sales increase, but just 45.1 percent following a prior sales decrease.

When managers are optimistic following a prior sales increase (and, potentially, other positive signals about future sales), they are more willing to retain slack in the event of a current sales decrease. This is because the retention of slack allows them to reduce not only current period adjustment costs, such as severance payments to laid-off workers, but also *future* adjustment costs such as hiring costs for new employees that they will have to incur when the anticipated future demand increase is realized.¹⁰ Thus, for the same current sales decrease, costs will fall to a lesser extent when managers are more optimistic. This effect of optimism further reinforces our prediction that costs in the current period are likely to be sticky conditional on a prior sales increase.

Conversely, when managers are pessimistic after observing a prior sales decrease (and, potentially, additional unfavorable signals), they are more willing to dispose of slack resources in the current period, because they are anticipating further resource cuts in near future. Therefore, for a given current sales decrease, costs will fall to a greater extent in the pessimistic case than in the optimistic case. This effect of pessimism further strengthens our prediction that costs in the current period are likely to be anti-sticky conditional on a prior sales decrease.

Managers are likely to exercise discretion not only when they cut resources (as in the standard cost stickiness model) but also when they expand resources in response to current sales increases. When managers are pessimistic about future sales, they are reluctant to commit additional resources. If demand decreases in the future, as anticipated, they will have to reverse these commitments, incurring adjustment costs twice—first to add resources and then to remove them. Therefore, when sales increase in the current period, pessimistic managers will only add

¹⁰ Notably, this implies that managers will retain slack resources even if the adjustment costs of resource reduction are zero, as long as they are facing significant adjustment costs associated with resource expansion.

resources that are absolutely necessary to accommodate current sales.¹¹ Conversely, when managers are optimistic about future sales, they are less hesitant about expanding resource levels, because they are much less likely to have to reverse these commitments in subsequent periods. Therefore, for a given sales increase in the current period, costs will rise to a greater extent in the optimistic case following a prior sales increase than in the pessimistic case following a prior sales decrease. Further, the change in the slope of cost response for sales increases will also affect the degree of cost asymmetry, contributing to greater stickiness conditional on a prior sales increase and greater anti-stickiness conditional on a prior sales decrease.¹²

We summarize these predictions as follows:

H1a: Conditional on a prior sales increase, costs in the current period are sticky on average, i.e., they rise more for concurrent sales increases than they fall for equivalent sales decreases.

H1b: Conditional on a prior sales decrease, costs in the current period are anti-sticky on average, i.e., they rise less for concurrent sales increases than they fall for equivalent sales decreases.

H2: For a given magnitude of a current sales increase, costs rise to a greater extent on average following a prior sales increase than following a prior sales decrease.

We also examine cost response conditional on the direction of sales changes in two prior periods, $t-1$ and $t-2$. This allows us to distinguish between “pure” optimistic and pessimistic

¹¹ If managers can temporarily increase capacity utilization above the sustainable long-term level, they might be able to accommodate a short-term sales increase with less than “normal” levels of practical capacity, further diminishing the extent of resource expansion. Additionally, unless managers are required to fully meet the demand due to contractual obligations, they may prefer to limit sales to available capacity rather than temporarily add resources.

¹² Another mechanism that can further strengthen our predictions of conditional stickiness and anti-stickiness is the impact of prior period sales change on free cash flows. Following a prior sales decrease, a firm is more likely to be cash-constrained, which limits managers’ ability both to retain slack resources and to acquire additional resources. This contributes to greater anti-stickiness. Conversely, in the case of a prior sales increase, free cash flows are higher, which enables managers to retain more slack or to acquire more new resources. This raises the degree of cost stickiness (Chen et al. 2012). We control for this effect in robustness checks.

scenarios, represented by two consecutive sales changes in a consistent direction, and “mixed” scenarios, corresponding to a decrease in period $t-2$ followed by an increase in period $t-1$ and vice versa.¹³ Because managers’ expectations in the mixed cases are more moderate, cost asymmetry is likely to be qualitatively similar but smaller in magnitude compared to the corresponding pure case, and cost response to current sales increases is likely to be stronger than in the pure pessimistic case and weaker than in the pure optimistic case. These predictions provide an additional test of the role of managerial expectations in cost behavior.

All of our predictions are robust to incorporation of agency and behavioral factors. For example, empire-building managers are reluctant to cut slack resources when sales decrease and are motivated to acquire additional resources when sales increase (Anderson et al. 2003; Chen et al. 2012). This can be thought of as managers’ personal, agency-related adjustment costs, which are positive for resource cuts but negative in the case of resource expansion, encouraging excessive resource commitments. Similar to economic adjustment costs borne by the firm, managers’ personal adjustment costs will lead them to retain more slack resources when sales decrease rather than increase, and will cause them to be more aggressive in their resource commitments when the expectations for future sales are optimistic rather than pessimistic. Thus, both mechanisms that we rely on to generate our predictions continue to be relevant in the context of agency-related adjustment costs.

Other behavioral factors may reduce managers’ willingness to commit resources. For example, if managers are loss-averse (Kahneman and Tversky 1984; Kahneman 2003; Tom et al. 2007), they are reluctant to retain slack when sales decrease, as doing so would increase the likelihood

¹³ We expect the more recent sales change to dominate, leading to mild optimism (pessimism) in the case of a decrease followed by an increase (increase followed by a decrease).

of losses.¹⁴ Likewise, when a manager is a hyperbolic discounter (Laibson 1997; Camerer et al. 2004; Dasgupta and Maskin 2005) or has a short horizon due to impending retirement (Dechow and Sloan 1991), he/she is less willing to sacrifice current profitability by keeping unused resources. However, as long as managers consider, even partially, the corresponding future benefits (i.e., the reduction in expected future adjustment costs due to well-planned retention of slack), they will typically retain slack in response to current sales decreases, and they will be more willing to do so in the optimistic case. This is sufficient to produce our predictions even when managers have both loss-aversion and short horizon. The extent of cost asymmetry is likely to be smaller, however, due to reduced incentives to retain slack. Thus, while behavioral factors do not affect the general structure of asymmetric cost behavior, they can either accentuate or diminish its magnitude.

Additional Proxies for Managers' Expectations

Managers likely rely on additional signals when they form their expectations for future sales.¹⁵ Therefore, even after controlling for the direction of prior period sales change, these signals are likely to affect cost behavior. In particular, signals that indicate more optimistic (or less pessimistic) expectations will strengthen cost stickiness conditional on a prior sales increase, will weaken cost anti-stickiness conditional on a prior sales decrease, and will magnify cost response for current sales increases.

¹⁴ The endowment effect (Thaler 1980; List 2004; Kahneman et al. 2008) and other behavioral foundations of the prospect theory (Kanheman and Tversky 1984) can further affect managers' incentives to retain slack, even in the absence of deliberate opportunistic behavior by managers.

¹⁵ From statistical perspective, the use of additional signals improves the accuracy of inferences about the outcome of interest, such as future sales in our analysis, as long as such signals contain incremental information about this outcome (see, for example, Holmstrom 1979 in the context of inferring agent's effort from multiple noisy signals). Additionally, managers' reliance on multiple signals can be viewed through the lens of behavioral economics. For example, the representativeness heuristic of Kahneman and Tversky (1974) suggests that managers identify patterns in sequences of events, such as multiple favorable or unfavorable signals about sales in our context. Our predictions are robust to both of these statistical and behavioral interpretations of managers' reliance on multiple signals.

H3a: Signals that indicate more optimistic expectations increase the degree of cost stickiness in the current period conditional on a prior sales increase and reduce the degree of cost anti-stickiness in the current period conditional on a prior sales decrease.

H3b: Signals that indicate more optimistic expectations increase the magnitude of cost response to current sales increases.

Implications for ABJ-type Cost Stickiness Estimates

The ABJ model is a single-period model, which does not condition on prior sales change direction. Therefore, standard cost stickiness estimates capture a weighted average of two opposing processes, cost stickiness conditional on a prior sales increase and cost anti-stickiness conditional on a prior sales decrease. Depending on the relative proportions of prior sales increases versus decreases in a particular sample, the ABJ model can yield findings of costs being sticky on average, anti-sticky on average, or even symmetric on average. In other words, all three types of asymmetry on average are consistent with ABJ's theory of managerial discretion and resource adjustment costs. Notably, this means that the theory cannot be formally tested using the ABJ model, because any type of results on average in the ABJ model would not lead to a rejection of the theory.¹⁶ Instead, the theory of managerial discretion and adjustment costs can be tested using our two-period model, in which the theory manifests as testable predictions of conditional stickiness and conditional anti-stickiness. Additionally, even when the estimates in the ABJ model indicate that cost behavior is symmetric (which would seem to be consistent with the traditional model of fixed and variable costs), it is symmetric *only on average*.

¹⁶ This does not alter ABJ's conclusions that the traditional model of fixed and variable costs should be rejected, because findings of a significant asymmetry on average in the ABJ model are inconsistent with the traditional model. In other words, when the null hypothesis is based on the traditional model of cost behavior, it can be rejected using the ABJ model. However, tests of the theory of asymmetric cost behavior focus on a different null hypothesis (i.e., the null hypothesis that this theory is valid), which cannot be rejected using the ABJ model.

Our two-period analysis of this “symmetric” scenario would reveal significant conditional asymmetries (which cancel each other out on average in single-period estimates, but are captured accurately in two-period analysis), leading to a rejection of the traditional model.

Because the long-term trends in sales are typically positive,¹⁷ the sticky process corresponding to prior sales increases is likely to outweigh the anti-sticky process for prior sales decreases. Therefore, studies that use the ABJ model are likely to detect cost stickiness on average in most datasets. Notably, in deriving our predictions of conditional cost asymmetry, we did not have to make any assumptions about the relative magnitudes of upward versus downward adjustment costs (such as hiring versus firing costs, respectively, in the context of labor resources). In other words, in a sample dominated by prior sales increase (decrease) observations, we expect to observe cost stickiness (anti-stickiness) on average regardless of whether the adjustment costs are larger in the upward direction or in the downward direction.¹⁸

Further, because the standard single-period estimates reflect only a weighted average of a much richer process of conditional stickiness and anti-stickiness, they do not take advantage of the information that is contained in prior period sales change direction. Incorporating this information is likely to improve both the explanatory and the predictive power of the analysis.

¹⁷ For example, 62.9% of observations in our Compustat sample are sales increases, and only 37.1% are sales decreases.

¹⁸ This does *not* mean that all cost categories are automatically expected to be sticky (anti-sticky) on average whenever a sample is dominated by prior sales increases (decreases). For example, if increases in labor productivity outpace average sales growth, then labor resources can exhibit anti-stickiness on average even when prior sales increases in the data outweigh prior sales decreases. Similarly, Banker et al. (2013) show that costs became anti-sticky on average during the economic crisis of 2008-2009, when managers’ expectations were unusually pessimistic.

DATA AND EMPIRICAL MODELS

Sample Selection and Descriptive Statistics

We use annual Compustat data from 1979-2009. Similar to ABJ, in our main analysis we focus on SG&A costs. We require firms to have valid sales data for years t to $t-2$ and valid SG&A data for years t to $t-1$. We also delete observations for which SG&A costs exceed sales, following ABJ, because such observations reflect unusually large commitments of SG&A resources.¹⁹ We deflate all financial variables to control for inflation, and winsorize the data at the top and bottom 1 percent. The final sample in the main analysis consists of 156,689 firm-year observations for 18,066 firms. In extension analyses, we examine the components of SG&A costs, including advertising expense, R&D expense and other SG&A costs, along with COGS and total employees. The variable definitions are summarized in Table 1.

[Insert Table 1 here]

The univariate descriptive statistics are presented in panel A of Table 2. The mean sales revenue is \$1,602 million (median \$125 million) and the mean SG&A cost is \$292 million (median \$25 million). On average, SG&A costs account for 26.0 percent of sales revenue (the median is 22.5 percent) and 27.8 percent of operating costs (the median is 24.9 percent), consistent with prior studies.

In panel B, we present descriptive statistics for the current period conditional on whether sales increased or decreased in the prior period. Both sales and SG&A costs are substantially lower following a prior sales decrease than following a prior sales increase. The average ratio of SG&A costs to sales is 25.4 percent conditional on a prior sales increase and 27.1 percent conditional on

¹⁹ To avoid potentially important biases (Banker and Byzalov 2013), we impose this criterion for both current and prior years. The results continue to hold when we do not use this criterion.

a prior sales decrease (the medians are 22.1 and 23.2 percent, respectively).²⁰ The ratio of SG&A costs to total operating costs does not change significantly with prior sales change direction (the mean is 27.8 percent in both subsamples; the median is 24.9 percent conditional on a prior sales increase versus 24.7 percent conditional on a prior sales decrease), suggesting that the behavior of SG&A costs is representative of broader patterns in cost behavior. Firms that experienced a prior sales decrease have significantly lower profit margin and free cash flows not only in the prior year but also in the current year, indicating that prior sales change direction has a persistent effect on firm performance. We also observe significant differences between the two subsamples in ABJ's observable determinants of cost stickiness—asset and employee intensity and GDP growth; we control for these differences in robustness checks.

[Insert Table 2 here]

Panel C of Table 2 presents the proportion of sales increases and decreases in the current and prior periods. The sample is dominated by observations that follow a prior sales increase (68.1 percent), for which costs are expected to be sticky (H1a). However, prior sales decrease observations, for which we expect the opposite pattern of anti-stickiness (H1b), account for 31.9 percent of the sample. Notably, prior sales change direction has a large impact on the likelihood of current period sales increases and decreases. Conditional on a prior sales increase, the probability of a current sales increase is 71.2 percent ($=48.5/68.1$). Following a prior sales decrease, however, this probability declines to 45.1 percent ($=14.4/31.9$). This evidence indicates that prior sales change direction is an important predictor of future sales.

As an informal test of our main predictions, in Panel D of Table 2 we present the median percentage change in sales revenue and SG&A costs in the current period conditional on the

²⁰ The higher SG&A cost ratio in the latter case may partly reflect the fixed component of SG&A costs, and can also reflect slack resources that were retained in response to a prior sales decrease.

direction of prior period sales change. Following a prior sales increase, SG&A costs are much more sensitive to current sales increases than to current sales decreases: they rise by 15.0 percent for a 17.0 percent median increase in sales, but fall by just 2.2 percent for a 9.1 percent median decrease in sales. This is consistent with ABJ and with our H1a. However, this pattern is reversed in the case of a prior sales decrease. SG&A costs are now *less* sensitive to current sales increases than to current sales decreases: they rise by 5.3 percent for a 10.8 percent median sales increase, and fall by 7.2 percent for an 11.2 percent median sales decrease. This evidence conflicts with the standard predictions of cost stickiness but is consistent with our H1b.

Empirical Models

ABJ examine cost stickiness using the following model:

ABJ model

$$\Delta \ln SGA_{i,t} = \beta_0 + \beta_1 \Delta \ln SALES_{i,t} + \beta_2 D_{i,t} \Delta \ln SALES_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $\Delta \ln SGA_{i,t}$ is the log-change in SG&A costs of firm i in year t relative to year $t-1$, $\Delta \ln SALES_{i,t}$ is the log-change in sales revenue, $D_{i,t}$ is a sales decrease dummy, equal to 1 if sales decreased in year t relative to year $t-1$ and zero otherwise, and $\varepsilon_{i,t}$ is an error term.

This model captures the average degree of asymmetry in cost behavior. However, because of its single-period structure, it does not distinguish between the two underlying processes of conditional stickiness and anti-stickiness. We refine the ABJ model to directly capture these fundamental processes, using the following two-period specification as our main model:

Model A

$$\begin{aligned} \Delta \ln SGA_{i,t} = & \beta_0 + I_{i,t-1} (\beta_1^{PIncr} \Delta \ln SALES_{i,t} + \beta_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t}) + \\ & + D_{i,t-1} (\beta_1^{PDecr} \Delta \ln SALES_{i,t} + \beta_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t}) + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where $I_{i,t-1}$ ($D_{i,t-1}$) is a dummy variable for a *prior* period sales increase (decrease), equal to 1 if sales increased (decreased) in year $t-1$ relative to year $t-2$ and zero otherwise, and all other variables were defined previously. The coefficients β_1^{PIncr} and β_2^{PIncr} (β_1^{PDegr} and β_2^{PDegr}) correspond to β_1 and β_2 in the ABJ model for the subsample of observations that follow a prior sales increase (decrease). Similar to ABJ, a negative β_2 indicates cost stickiness, i.e., costs falling less for sales decreases than they rise for equivalent sales increases. Conversely, a positive β_2 corresponds to cost anti-stickiness, i.e., costs falling to a greater extent for sales decreases than they rise for sales increases. H1a and H1b imply that β_2^{PIncr} is negative and β_2^{PDegr} is positive, reflecting stickiness and anti-stickiness, respectively. H2 implies that $\beta_1^{PIncr} > \beta_1^{PDegr}$, i.e., for a given magnitude of a current period sales increase, costs rise to a greater extent in the case of a prior sales increase than in the case of a prior sales decrease.

Similar to ABJ, we employ a log-log specification rather than a linear specification. This choice is based on two considerations. First, Davidson and MacKinnon (1981) test rejects the linear model in favor of the log-log model. Second, estimates in a linear model are likely to suffer from heteroscedasticity because of size differences across firms. The log-log specification alleviates this problem, improving the efficiency of estimates.

We also estimate a three-period extension of our main model, in which the slopes β_1 and β_2 are estimated conditional on the directions of sales changes in two prior periods:

Model B

$$\begin{aligned}
\Delta \ln SGA_{i,t} = & \beta_0 + I_{i,t-2} I_{i,t-1} (\beta_1^{PIncrIncr} \Delta \ln SALES_{i,t} + \beta_2^{PIncrIncr} D_{i,t} \Delta \ln SALES_{i,t}) + \\
& + D_{i,t-2} I_{i,t-1} (\beta_1^{PDegrIncr} \Delta \ln SALES_{i,t} + \beta_2^{PDegrIncr} D_{i,t} \Delta \ln SALES_{i,t}) + \\
& + I_{i,t-2} D_{i,t-1} (\beta_1^{PIncrDecr} \Delta \ln SALES_{i,t} + \beta_2^{PIncrDecr} D_{i,t} \Delta \ln SALES_{i,t}) + \\
& + D_{i,t-2} D_{i,t-1} (\beta_1^{PDegrDecr} \Delta \ln SALES_{i,t} + \beta_2^{PDegrDecr} D_{i,t} \Delta \ln SALES_{i,t}) + \varepsilon_{i,t}
\end{aligned} \tag{3}$$

where $I_{i,t-2}$ ($D_{i,t-2}$) is a dummy variable for a sales increase (decrease) in year $t-2$ relative to year

$t-3$, and the remainder of variables are defined previously. As discussed earlier, we expect to observe strong stickiness in the “pure” optimistic case ($I_{i,t-2}=I_{i,t-1}=1$), strong anti-stickiness in the “pure” pessimistic case ($D_{i,t-2}=D_{i,t-1}=1$), and more moderate levels of stickiness and anti-stickiness, respectively, in the corresponding “mixed” cases ($D_{i,t-2}=I_{i,t-1}=1$ and $I_{i,t-2}=D_{i,t-1}=1$, respectively). Similarly, for current sales increases, we expect the slope β_1 to be highest in the pure optimistic case and lowest in the pure pessimistic case.

In our next model, we incorporate two additional signals for future sales—order backlog following Lev and Thiagarajan (1993) and Rajgopal et al. (2003), and GDP growth following Lev and Thiagarajan (1993) and ABJ.

Model C

$$\begin{aligned}
\Delta \ln SGA_{i,t} = & \beta_0 + I_{i,t-1}(\beta_1^{PIncr} \Delta \ln SALES_{i,t} + \beta_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t} + \\
& + \delta_1^{PIncr} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \delta_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \\
& + \lambda_1^{PIncr} \Delta \ln SALES_{i,t} \Delta GDP_t + \lambda_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t} \Delta GDP_t) + \\
& + D_{i,t-1}(\beta_1^{PDecr} \Delta \ln SALES_{i,t} + \beta_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t} + \\
& + \delta_1^{PDecr} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \delta_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \\
& + \lambda_1^{PDecr} \Delta \ln SALES_{i,t} \Delta GDP_t + \lambda_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t} \Delta GDP_t) + \\
& + \beta_3 \Delta \ln SALES_{i,t} ASINT_{i,t} + \beta_4 \Delta \ln SALES_{i,t} EMPINT_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{4}$$

where $\Delta ORD_{i,t}$ is the log-change in order backlog of firm i in year t , ΔGDP_t is the GDP growth rate in year t , $ASINT_{i,t}$ is asset intensity (log-ratio of total assets to sales), $EMPINT_{i,t}$ is employee intensity (log-ratio of total employees to sales), and the remainder of terms are defined previously. Asset and employee intensity are standard proxies for the magnitude of adjustment costs, following ABJ. The sample size in this analysis is reduced because of limited data availability for order backlog.

Higher order backlog and higher GDP growth indicate greater optimism about future sales. H3a implies that the coefficients δ_2^{PIncr} , δ_2^{PDecr} for order backlog and λ_2^{PIncr} , λ_2^{PDecr} for GDP growth

are negative, representing increased stickiness (or reduced anti-stickiness). H3b predicts that the coefficients δ_1^{PIncr} , δ_1^{PDecr} for order backlog and λ_1^{PIncr} , λ_1^{PDecr} for GDP growth are positive, indicating stronger cost response to concurrent sales increases.

In supplementary analysis, we consider analysts' sales forecasts from I/B/E/S as an alternative signal. We define $\Delta AF_{i,t}$ as the log-ratio of consensus sales forecast for year $t+1$ to actual sales in year t , and substitute $\Delta AF_{i,t}$ in place of $\Delta ORD_{i,t}$ in Model C.²¹

EMPIRICAL RESULTS

The estimates for our main two-period model, Model A, are presented in Table 3.²² As expected, SG&A costs exhibit significant stickiness only following a prior sales increase ($\beta_2^{PIncr} = -0.413, t = -18.33$), and they reveal the opposite pattern of significant anti-stickiness in the case of a prior sales decrease ($\beta_2^{PDecr} = 0.175, t = 9.58$). These results support H1a and H1b, respectively.²³

[Insert Table 3 here]

²¹ Analysts' sales forecasts are likely based on much of the same information that managers use in forming their own expectations. To the extent that managers' expectations of future firm performance are correlated with the information sets used by analysts in setting their forecasts (Kothari 2001), analysts' forecasts may also directly reflect managers' expectations. Because analysts' sales forecasts in I/B/E/S are available only beginning in year 1997, we do not include $\Delta AF_{i,t}$ in the main version of Model C.

²² We estimate all models using pooled OLS with two-way clustering by firm and year (Petersen 2009). The results continue to hold when we use one-way clustering by firm combined with year fixed effects. The results are also similar when we use Fama-MacBeth estimation (Fama and MacBeth 1973). However, Petersen shows that in the presence of firm effects, the Fama-MacBeth approach can yield biased standard errors. Therefore, he recommends that researchers use two-way clustering, which is robust to both firm and time effects.

²³ We also estimate the model after controlling for prior period free cash flows, which directly affect cost stickiness (Chen et al. 2012), and which are significantly lower in the case of a prior sales decrease (panel B of Table 2). Similar to our main results, the estimates in this robustness check indicate significant stickiness conditional on a prior sales increase and significant anti-stickiness conditional on a prior sales decrease ($\beta_2^{PIncr} = -0.466, t = -17.31$ and $\beta_2^{PDecr} = 0.115, t = 3.88$, respectively). Further, the impact of prior sales change direction on the degree of cost asymmetry (i.e., the difference between β_2^{PIncr} and β_2^{PDecr}) is similar to that in our main estimates. This indicates that the impact of cash constraints on cost behavior is largely orthogonal to the two mechanisms that we focus on, retained slack and managerial expectations. In further robustness checks, we include additional control variables, including asset intensity, employee intensity, GDP growth, firm size (proxied by the natural logarithm of total assets), and prior period profit margin. The results continue to hold in all of these robustness checks.

Consistent with ABJ's findings, these estimates indicate that costs are sticky *on average*: weighted by the proportions of prior sales increases and decreases from Panel C of Table 2, the average degree of cost asymmetry is $\beta_2 = 0.681 \times \beta_2^{P_{Inc}} + 0.319 \times \beta_2^{P_{Dec}} = -0.225$, negative and significant at the 1 percent level. However, as our findings of conditional stickiness and anti-stickiness make clear, standard single-period estimates capture only a weighted average of two starkly different conditional asymmetries, masking a much richer process of asymmetric cost behavior.

In extension analysis, we estimate Model A for each of the main components of SG&A costs (advertising costs, R&D costs, and other SG&A costs), for COGS and for the number of employees (Table 3). For all of these cost categories, the estimates indicate significant stickiness conditional on a prior sales increase and significant anti-stickiness conditional on a prior sales decrease ($\beta_2^{P_{Inc}} < 0$ and $\beta_2^{P_{Dec}} > 0$, respectively), lending further support to H1a and H1b. These results confirm that our main findings are not driven by any particular component of SG&A costs, and demonstrate that the asymmetries that we document for SG&A costs are representative of a broader pattern of asymmetric cost behavior, which extends to all of the major components of operating costs and also holds for physical input quantity for labor.²⁴

The standard cost stickiness model allows managerial discretion only for sales decreases, and assumes mechanistic resource expansion for sales increases. However, the estimates indicate that when sales are increasing, deliberate managerial decisions play an equally important role. For all cost categories in Table 3, cost response to current sales increases is substantially stronger following a prior sales increase than following a prior sales decrease (i.e., $\beta_1^{P_{Inc}} > \beta_1^{P_{Dec}}$), and

²⁴ The results for the number of employees alleviate potential concerns that observed asymmetries in cost behavior could be driven by changes in input prices. In another robustness check, we replace the log-log model with a sales-deflated linear model. The results continue to hold for all cost categories.

the difference is significant at the 1 percent level, supporting H2. Further, this effect is highly economically significant. For example, when current sales increase by 1 percent, SG&A costs rise by 0.74 percent conditional on a prior sales increase ($\beta_1^{PIncr} = 0.741$) but rise by just 0.42 percent conditional on a prior sales decrease ($\beta_1^{PDecr} = 0.419$), i.e., cost expansion in the latter case is approximately 43 percent weaker.

A cost category of particular interest in this analysis is total employees. Some prior studies report that the number of employees does not exhibit significant cost stickiness (in the ABJ model), which appears to be consistent with the traditional model of fixed and variable costs. This leads them to question ABJ's theory of sticky costs. We obtain qualitatively similar estimates when we use the ABJ model. However, when we employ our two-period model, the inferences are starkly different: the estimates indicate significant stickiness following a prior sales increase ($\beta_2^{PIncr} = -0.149, t = -4.14$) and significant anti-stickiness following a prior sales decrease ($\beta_2^{PDecr} = 0.156, t = 5.68$). These results decisively reject the traditional model and are consistent with the theory of asymmetric cost behavior. The results also underscore the value-added of our two-period analysis, which in the case of total employees is essential for drawing accurate inferences about the nature of cost behavior.

In supplementary analysis, we estimate the three-period Model B, in which the degree of cost asymmetry in period t is conditioned on the direction of sales changes in two prior periods, $t-1$ and $t-2$. The estimates are presented in Table 4. As expected, cost stickiness is stronger in the “pure” optimistic case, proxied by two prior sales increases, than in the “mixed” optimistic case, represented by a sales decrease in period $t-2$ followed by an increase in period $t-1$ ($\beta_2^{PIncrIncr} = -0.462$ versus $\beta_2^{PDecrIncr} = -0.209$, respectively). Similarly, cost anti-stickiness is stronger in the case of pure pessimism, corresponding to two prior sales decreases, than in the

case of mixed pessimism, proxied by a sales increase in period $t-2$ followed by an decrease in period $t-1$ ($\beta_2^{PDegrDegr} = 0.273$ versus $\beta_2^{PIncrDegr} = 0.086$, respectively). Also consistent with the theory, the extent of cost expansion for current sales increases is greater when managerial expectations are more positive, ranging from $\beta_1^{PDegrDegr} = 0.367$ in the pure pessimistic case to $\beta_1^{PIncrIncr} = 0.782$ in the pure optimistic case. These results further confirm that managerial expectations play an important role in cost behavior.

[Insert Table 4 here]

Estimates for Additional Indicators of Future Sales

In Model C, we control for two additional signals, GDP growth and order backlog. The estimates are presented in the first column of Table 5. As expected, higher order backlog, a positive signal about future sales, is associated with significantly greater cost stickiness conditional on a prior sales increase ($\delta_2^{PIncr} = -0.170, t = -4.25$), and is associated with significantly lower cost anti-stickiness conditional on a prior sales decrease ($\delta_2^{PDegr} = -0.252, t = -7.10$). These estimates support H3a, further validating the importance of managerial expectations in cost behavior. As expected, higher order backlog is also associated with greater cost expansion for current sales increases ($\delta_1^{PIncr} = 0.047, t = 2.40$ and $\delta_1^{PDegr} = 0.185, t = 6.13$). These results support H3b and provide additional evidence that deliberate decisions by forward-looking managers affect cost behavior not only for sales decreases (as in the standard model of sticky costs) but also in the context of resource expansion for sales increases. The coefficients on GDP growth are insignificant, suggesting that after controlling for order backlog, GDP provides no incremental information about future sales.

[Insert Table 5 here]

In additional sensitivity analysis, we use an alternative signal that is based on analysts' sales forecasts, $\Delta AF_{i,t}$ in the second column of Table 5. The coefficient estimates for analysts' sales forecasts are generally consistent with those for order backlog, supporting H3a and H3b.²⁵

In summary, the evidence presented in Tables 3-5 supports our refined theory of asymmetric cost behavior, which is based on deliberate managerial decisions and resource adjustment costs, and which explicitly recognizes the impact of managers' expectations on cost behavior.

CONCLUSION

In this paper, we refined the standard theory of sticky costs. Building on ABJ's intuition of deliberate managerial decisions in the presence of resource adjustment costs, we showed that this intuition gives rise to a complex fundamental pattern of cost asymmetry that combines two distinct processes: cost stickiness conditional on a prior sales increase, and cost anti-stickiness—the opposite of the standard predictions—conditional on a prior sales decrease. These predictions reflect the impact of managers' expectations for future sales on their current resource commitments, along with the general structure of optimal decisions with resource adjustment costs.

We proposed a new two-period model of asymmetric cost behavior, which incorporates these theoretical insights rigorously and parsimoniously. Empirical estimates for Compustat data are consistent with all of our hypotheses, lending support to our modified theory of asymmetric cost

²⁵ The coefficients ψ_1^{PDecr} , ψ_2^{PDecr} for prior sales decrease observations are statistically insignificant. Because sample size in this analysis is substantially reduced due to limited availability of analysts' sales forecasts, and prior sales decrease observations account for a relatively small fraction of this reduced sample, the insignificant estimates are likely due to small sample size. Additionally, because sales decreases are associated with more substantial operational changes, analysts' sales forecasts following a prior sales decrease are likely to be significantly less accurate.

behavior. The results are robust across multiple cost categories, including all of the major components of operating costs and including physical number of employees. Tests for additional proxies of managerial optimism and pessimism further confirm that managerial expectations for future sales play a central role in cost behavior.

Our results support ABJ's fundamental insight that asymmetric cost behavior reflects deliberate resource commitments by forward-looking managers. However, the results also indicate that the standard view of cost stickiness can be refined substantially by incorporating the insights from our two-period model. For example, because the standard model of sticky costs captures only a weighted average of two opposing conditional asymmetries, stickiness and anti-stickiness, it does not take advantage of the information that is contained in the main determinant of these asymmetries—the direction of prior period sales change. By incorporating this information, our two-period model enhances the researcher's ability both to explain and to predict cost behavior. Better understanding of cost behavior has useful implications not only for cost accounting but also for financial accounting topics such as earnings forecasts and earnings management.²⁶

Our theoretical predictions and empirical findings are robust to multiple interpretations of resource adjustment costs and managerial expectations. For example, the adjustment costs can represent both economic costs incurred by the firm and agency-related costs borne by managers. Similarly, managerial optimism and pessimism can reflect both rational inferences about future demand and behavioral biases. While all of these mechanisms produce qualitatively similar

²⁶ In untabulated results, we find that incorporating our two-period specification of cost behavior into the earnings prediction model of Banker and Chen (2006) leads to a significant improvement in earnings forecast accuracy. When we revisit the relation between earnings management incentives and cost stickiness (Kama and Weiss 2013) using our two-period specification, we find that incentives to avoid losses have a much greater impact on cost behavior following a prior sales decrease than following a prior sales increase. This suggests that managers face greater pressure to meet an earnings target by cutting resources when prior sales change reflects poorly on their performance, a new insight into the drivers of real earnings management.

predictions for asymmetries in cost behavior, they can have starkly different implications for other aspects of firm performance. For example, deliberate retention of slack resources contributes to firm value if managers aim to reduce economic adjustment costs, but it can be value-destroying if managers are motivated by their personal, agency-related adjustment costs (Anderson et al. 2003; Chen et al. 2012). Likewise, increased cost stickiness in the optimistic case is beneficial to the firm if optimism reflects managers' rational assessment of future sales, but it can be detrimental to the firm if optimism arises from managerial overconfidence (Chen et al. 2013). The implications of asymmetric cost behavior are further affected by behavioral factors such as the endowment effect (Kahneman et al. 2008; List 2004), hyperbolic discounting (Laibson 1997; Camerer et al. 2004; Dasgupta and Maskin 2005) and loss aversion (Kahneman and Tversky 1984; Kahneman 2003). Future research incorporating insights from behavioral economics will contribute to better understanding of both the drivers and the implications of asymmetric cost behavior. Further, because costs are a major component of earnings, insights into cost behavior contribute not only to cost accounting research but also to financial accounting topics that rely on understanding or forecasting earnings behavior.

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TABLE 1
Variable Definitions

$\Delta \ln SALES_{i,t}$	= log-change in sales revenue (Compustat item SALE) of firm i in year t relative to year $t-1$;
$\Delta \ln SGA_{i,t}$	= log-change in selling, general and administrative expenses (Compustat item XSGA) of firm i in year t ;
$\Delta \ln AD_{i,t}$	= log-change in advertising expense (Compustat item XAD) of firm i in year t ;
$\Delta \ln RD_{i,t}$	= log-change in R&D expense (Compustat item XRD) of firm i in year t ;
$\Delta \ln OTHERSGA_{i,t}$	= log-change in other SG&A expense (Compustat items XSGA-XAD-XRD) of firm i in year t ;
$\Delta \ln COGS_{i,t}$	= log-change in cost of goods sold (Compustat item COGS) of firm i in year t ;
$\Delta \ln EMP_{i,t}$	= log-change in the number of employees (Compustat item EMP) of firm i in year t ;
$\Delta ORD_{i,t}$	= log-change in order backlog (Compustat item OB) of firm i in year t ;
ΔGDP_t	= GDP growth in year t . Source: http://www.bea.gov/briefirm/gdp.htm ;
$ASINT_{i,t}$	= asset intensity, defined as the log-ratio of total assets to sales, $\ln(AT/SALE)$;
$EMPINT_{i,t}$	= employee intensity, defined as the log-ratio of number of employees to sales, $\ln(EMP/SALE)$;
$\Delta AF_{i,t}$	= log-ratio of consensus (mean) sales forecast for year $t+1$ to actual sales in year t , both from I/B/E/S summary files. The analyst forecast is the latest consensus forecast made in year t ;
$I_{i,t}$	= 1 if sales revenue of firm i increased in year t relative to year $t-1$, zero otherwise;
$D_{i,t}$	= 1 if sales revenue of firm i decreased in year t relative to year $t-1$, zero otherwise.

TABLE 2
Descriptive Statistics

Panel A: Univariate Descriptive Statistics

	Mean	Standard deviation	Lower quartile	Median	Upper quartile
Sales revenue, \$ million	1,602	8,420	29	125	580
SG&A costs, \$ million	292	1,434	6	25	104
SG&A costs / sales	0.260	0.173	0.133	0.225	0.341
SG&A costs / operating costs	0.278	0.170	0.146	0.249	0.379
Order backlog ratio	1.076	0.407	0.813	1.005	1.250
Total assets / sales	2.334	3.774	0.610	0.924	1.710
Number of employees per \$1,000 of sales	0.0092	0.0087	0.0039	0.0066	0.0115

Panel B: Univariate Descriptive Statistics Conditional on Prior Sales Change Direction

	Mean			Median		
	Prior increase	Prior decrease	t-test for difference	Prior increase	Prior decrease	z-test for difference
Sales revenue, \$ million	1,725	1,377	7.81***	147	88	41.73 ⁺⁺⁺
SG&A costs, \$ million	312	255	7.56***	29	18	39.80 ⁺⁺⁺
SG&A costs / sales	0.254	0.271	-19.18***	0.221	0.232	-15.52 ⁺⁺⁺
SG&A costs / operating costs	0.278	0.278	0.29	0.249	0.247	0.29
Order backlog ratio	1.087	1.059	6.17***	1.021	0.979	9.44 ⁺⁺⁺
Total assets / sales	2.373	2.262	5.60***	0.935	0.902	8.68 ⁺⁺⁺
Number of employees per \$1,000 of sales	0.0090	0.0096	-11.11***	0.0064	0.0070	-19.13 ⁺⁺⁺
GDP growth	2.77%	2.63%	12.80***	3.10%	3.10%	12.36 ⁺⁺⁺
Profit margin	0.141	0.085	48.00***	0.123	0.081	69.90 ⁺⁺⁺
Lagged profit margin	0.153	0.077	64.04***	0.129	0.077	90.32 ⁺⁺⁺
Free cash flows / assets	0.058	0.029	33.12***	0.066	0.045	37.17 ⁺⁺⁺
Lagged free cash flows / assets	0.057	0.026	30.15***	0.065	0.046	35.32 ⁺⁺⁺

The table presents the means and medians in two subsamples: observations that follow a prior sales increase, and observations that follow a prior sales decrease. *** (⁺⁺⁺) indicates that the difference between the two subsamples is significant at the 1 percent level in a *t*-test (Wilcoxon signed rank test).

Panel C: Joint Distribution of Sales Change Direction in the Prior and Current Periods

	Current increase	Current decrease	Marginal total
Prior increase	48.5%	19.6%	68.1%
Prior decrease	14.4%	17.5%	31.9%
Marginal total	62.9%	37.1%	100%

The table presents the proportion of firm-year observations in the full sample that correspond to each possible combination of prior and current sales change direction.

Panel D: Median Percentage Increase (Decrease) in Sales and SG&A Costs Conditional on Prior Period Sales Change Direction

		Current sales increase	Current sales decrease
Conditional on a prior sales increase	% change in sales revenue	17.0%	(9.1)%
	% change in SG&A costs	15.0%	(2.2)%
Conditional on a prior sales decrease	% change in sales revenue	10.8%	(11.2)%
	% change in SG&A costs	5.3%	(7.2)%

The table presents the median percentage change in sales and SG&A costs in four subsamples, partitioned on the direction of sales change in prior and current periods.

TABLE 3
Estimates for the Two-Period Model (Model A)

$$\Delta \ln SGA_{i,t} = \beta_0 + I_{i,t-1}(\beta_1^{PIncr} \Delta \ln SALES_{i,t} + \beta_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t}) + D_{i,t-1}(\beta_1^{PDecr} \Delta \ln SALES_{i,t} + \beta_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t}) + \varepsilon_{i,t}$$

Variable	Pred. sign	SG&A costs	Robustness checks for other cost categories				
			advertising costs	R&D costs	other SG&A	COGS	number of employees
$\beta_1^{PIncr} I_{i,t-1} \Delta \ln SALES_{i,t}$	+	0.741*** (55.01)	0.792*** (33.91)	0.706*** (36.57)	0.721*** (54.41)	0.981*** (164.73)	0.624*** (38.88)
$\beta_2^{PIncr} I_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t}$	-	-0.413*** (-18.33)	-0.147** (-2.38)	-0.468*** (-12.13)	-0.397*** (-18.56)	-0.158*** (-9.09)	-0.149*** (-4.14)
$\beta_1^{PDecr} D_{i,t-1} \Delta \ln SALES_{i,t}$	+	0.419*** (33.70)	0.480*** (12.22)	0.255*** (7.15)	0.416*** (37.41)	0.864*** (70.45)	0.416*** (25.94)
$\beta_2^{PDecr} D_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t}$	+	0.175*** (9.58)	0.461*** (6.95)	0.365*** (6.93)	0.153*** (8.89)	0.067*** (2.91)	0.156*** (5.68)
N		156,689	52,116	58,501	156,281	156,019	139,789
Adjusted R ²		0.4330	0.1437	0.1127	0.3878	0.7203	0.3152

*, **, *** indicates significance at 10, 5 and 1 percent levels, respectively. The numbers in parentheses are the *t*-statistics, based on two-way clustering by firm and year (Petersen 2009). The variable definitions are provided in Table 1.

TABLE 4
Estimates for the Three-Period Model (Model B)

$$\begin{aligned} \Delta \ln SGA_{i,t} = & \beta_0 + I_{i,t-2}I_{i,t-1}(\beta_1^{PIncrIncr} \Delta \ln SALES_{i,t} + \beta_2^{PIncrIncr} D_{i,t} \Delta \ln SALES_{i,t}) + \\ & + D_{i,t-2}I_{i,t-1}(\beta_1^{PDecrIncr} \Delta \ln SALES_{i,t} + \beta_2^{PDecrIncr} D_{i,t} \Delta \ln SALES_{i,t}) + \\ & + I_{i,t-2}D_{i,t-1}(\beta_1^{PIncrDecr} \Delta \ln SALES_{i,t} + \beta_2^{PIncrDecr} D_{i,t} \Delta \ln SALES_{i,t}) + \\ & + D_{i,t-2}D_{i,t-1}(\beta_1^{PDecrDecr} \Delta \ln SALES_{i,t} + \beta_2^{PDecrDecr} D_{i,t} \Delta \ln SALES_{i,t}) + \varepsilon_{i,t} \end{aligned}$$

	Variable	Pred. sign	Estimates
$\beta_1^{PIncrIncr}$	$I_{i,t-2}I_{i,t-1}\Delta \ln SALES_{i,t}$	+	0.782*** (55.24)
$\beta_2^{PIncrIncr}$	$I_{i,t-2}I_{i,t-1}D_{i,t}\Delta \ln SALES_{i,t}$	-	-0.462*** (-18.55)
$\beta_1^{PDecrIncr}$	$D_{i,t-2}I_{i,t-1}\Delta \ln SALES_{i,t}$	+	0.589*** (43.03)
$\beta_2^{PDecrIncr}$	$D_{i,t-2}I_{i,t-1}D_{i,t}\Delta \ln SALES_{i,t}$	-	-0.209*** (-8.61)
$\beta_1^{PIncrDecr}$	$I_{i,t-2}D_{i,t-1}\Delta \ln SALES_{i,t}$	+	0.461*** (36.12)
$\beta_2^{PIncrDecr}$	$I_{i,t-2}D_{i,t-1}D_{i,t}\Delta \ln SALES_{i,t}$	+	0.086*** (3.91)
$\beta_1^{PDecrDecr}$	$D_{i,t-2}D_{i,t-1}\Delta \ln SALES_{i,t}$	+	0.367*** (22.21)
$\beta_2^{PDecrDecr}$	$D_{i,t-2}D_{i,t-1}D_{i,t}\Delta \ln SALES_{i,t}$	+	0.273*** (12.25)
	N		143,677
	Adjusted R ²		0.4267

*, **, *** indicates significance at 10, 5 and 1 percent levels, respectively. The numbers in parentheses are the *t*-statistics, based on two-way clustering by firm and year (Petersen 2009). The variable definitions are provided in Table 1.

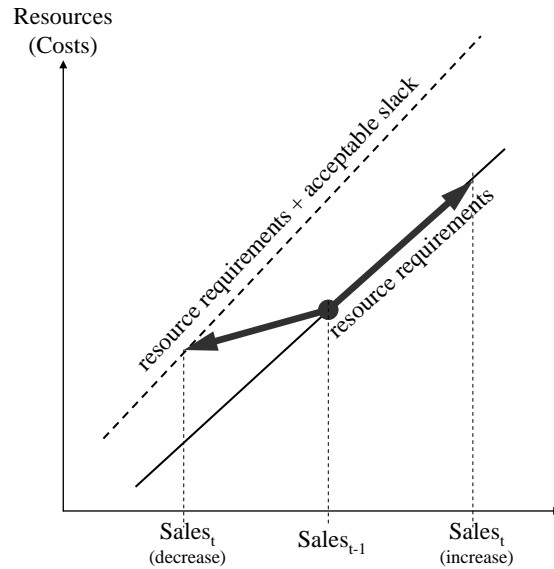
TABLE 5

Estimates for Additional Indicators of Future Sales (Model C)

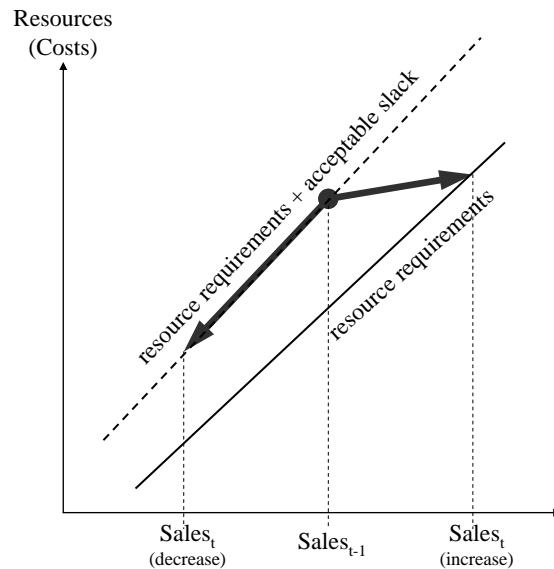
$$\begin{aligned} \Delta \ln SGA_{i,t} = & \beta_0 + I_{i,t-1}(\beta_1^{PIncr} \Delta \ln SALES_{i,t} + \beta_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t} + \delta_1^{PIncr} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \\ & + \delta_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \lambda_1^{PIncr} \Delta \ln SALES_{i,t} \Delta GDP_t + \lambda_2^{PIncr} D_{i,t} \Delta \ln SALES_{i,t} \Delta GDP_t) + \\ & + D_{i,t-1}(\beta_1^{PDecr} \Delta \ln SALES_{i,t} + \beta_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t} + \delta_1^{PDecr} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \\ & + \delta_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t} \Delta ORD_{i,t} + \lambda_1^{PDecr} \Delta \ln SALES_{i,t} \Delta GDP_t + \lambda_2^{PDecr} D_{i,t} \Delta \ln SALES_{i,t} \Delta GDP_t) + \\ & + \beta_3 \Delta \ln SALES_{i,t} ASINT_{i,t} + \beta_4 \Delta \ln SALES_{i,t} EMPINT_{i,t} + \varepsilon_{i,t} \end{aligned}$$

	Variable	Pred. sign	Model C	Model C'
β_1^{PIncr}	$I_{i,t-1} \Delta \ln SALES_{i,t}$	+	0.800*** (17.43)	1.016*** (19.29)
β_2^{PIncr}	$I_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t}$	-	-0.402*** (-9.21)	-0.384*** (-9.44)
δ_1^{PIncr}	$I_{i,t-1} \Delta \ln SALES_{i,t} \Delta ORD_{i,t}$	+	0.047** (2.40)	
δ_2^{PIncr}	$I_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t} \Delta ORD_{i,t}$	-	-0.170*** (-4.25)	
λ_1^{PIncr}	$I_{i,t-1} \Delta \ln SALES_{i,t} \Delta GDP_t$	+	0.005 (0.95)	0.010 (1.29)
λ_2^{PIncr}	$I_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t} \Delta GDP_t$	-	-0.008 (-0.58)	-0.018** (-2.18)
ψ_1^{PIncr}	$I_{i,t-1} \Delta \ln SALES_{i,t} \Delta AF_{i,t}$	+		0.134** (2.41)
ψ_2^{PIncr}	$I_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t} \Delta AF_{i,t}$	-		-0.400*** (-5.15)
β_1^{PDecr}	$D_{i,t-1} \Delta \ln SALES_{i,t}$	+	0.448*** (8.11)	0.887*** (13.48)
β_2^{PDecr}	$D_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t}$	+	0.184*** (2.75)	0.012 (0.28)
δ_1^{PDecr}	$D_{i,t-1} \Delta \ln SALES_{i,t} \Delta ORD_{i,t}$	+	0.185*** (6.13)	
δ_2^{PDecr}	$D_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t} \Delta ORD_{i,t}$	-	-0.252*** (-7.10)	
λ_1^{PDecr}	$D_{i,t-1} \Delta \ln SALES_{i,t} \Delta GDP_t$	+	0.000 (0.01)	-0.029*** (-2.62)
λ_2^{PDecr}	$D_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t} \Delta GDP_t$	-	0.010 (0.51)	0.033** (2.25)
ψ_1^{PDecr}	$D_{i,t-1} \Delta \ln SALES_{i,t} \Delta AF_{i,t}$	+		-0.225 (-1.58)
ψ_2^{PDecr}	$D_{i,t-1} D_{i,t} \Delta \ln SALES_{i,t} \Delta AF_{i,t}$	-		-0.149 (-0.90)
β_3	$\Delta \ln SALES_{i,t} ASINT_{i,t}$	-	-0.029** (-2.30)	-0.043*** (-3.34)
β_4	$\Delta \ln SALES_{i,t} EMPINT_{i,t}$	-	0.013 (1.55)	0.052*** (5.29)
	N		35,384	18,384
	Adjusted R ²		0.4767	0.5134

*, **, *** indicates significance at 10, 5 and 1 percent levels, respectively. The numbers in parentheses are the *t*-statistics, based on two-way clustering by firm and year (Petersen 2009). The variable definitions are provided in Table 1. In Model C', order backlog $\Delta ORD_{i,t}$ is replaced with analysts' sales forecasts $\Delta AF_{i,t}$.



Panel A. Cost Stickiness Conditional on a Prior Sales Increase



Panel B. Cost Anti-Stickiness Conditional on a Prior Sales Decrease

FIGURE 1

Stickiness and Anti-Stickiness Conditional on Prior Period Sales Change Direction

In panel A, sales increased sufficiently in prior period $t-1$, and managers added only the required resources. Therefore, costs in period $t-1$ reflect resource requirements (the lower line). If sales increase further in current period t , costs will expand proportionately along the resource requirements line (the upward arrow). If sales decrease in current period t , however, managers will cut resources only after they have retained the maximum acceptable slack, and cost response will involve a transition from zero slack to maximum slack (the downward arrow).

In panel B, sales decreased sufficiently in prior period $t-1$, and managers retained maximum acceptable slack. Therefore, costs in period $t-1$ are determined by the upper line. If sales decrease further in current period t , costs will decrease proportionately along the same line, because managers maintain the same maximum level of slack (the downward arrow). If sales increase in the current period, however, managers will add resources only after they have used up the initial slack, and cost response will involve a transition from maximum slack to zero slack (the upward arrow).