

DO MANAGERS' DELIBERATE DECISIONS  
INDUCE STICKY COSTS?

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## **Do managers' deliberate decisions induce sticky costs?**

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### **Abstract**

This study explores motivations underlying managers' resource adjustments. We examine asymmetric costs resulting from *current* resource adjustments made intentionally to meet earnings targets under constraints set by *past* technology choices aimed to maximize firm value. Findings indicate that early technology choices induce cost stickiness in the absence of incentives to meet earnings targets. Costs exhibit greater stickiness in the presence of hard technological constraints than in the presence of weak technological constraints. However, resource adjustments made intentionally to meet earnings targets wash away, rather than induce, cost stickiness imposed by pre-determined technological constraints, resulting in symmetric costs. The findings suggest that some deliberate decisions induce sticky costs while other deliberate decisions diminish sticky costs depending on the underlying motivations.

## **Do managers' deliberate decisions induce sticky costs?**

### *1. Introduction*

Managerial decisions resulting in asymmetric cost behavior have recently attracted much attention. Anderson, Banker and Janakiraman (2003, p. 47), hereafter ABJ, argue that “*Sticky costs occur because managers deliberately adjust the resources committed to activities.*” Understanding how motivations underlying managers’ deliberate choices to adjust the resources influence the observed sticky cost behavior is of particular interest to management accounting scholars. The literature, however, has scarcely documented such relationships, perhaps because incentives are neither observable, nor obvious.<sup>1</sup> Moreover, the ability to adjust resources in response to realized demand is subject to constraints imposed by technology choices made in prior periods. For instance, a choice to acquire a machine made in a past period may restrict the short-run ability to produce above capacity when demand rises, and depreciation costs hold back savings in case of downward adjustments when demand falls. Notwithstanding its importance, the impact of pre-determined constraints on resource adjustments resulting in cost stickiness is not well understood. The objective of this study is to distinguish between two potential sources of sticky costs: deliberate decisions to adjust resources made by self-interested managers and constraints imposed by past technology choices made to maximize firm value. We explore current resource adjustments made intentionally to meet earnings targets under pre-determined technological constraints. Particularly, we examine a potential tension between the two effects on the observed cost stickiness.

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<sup>1</sup> As an exception, Chen, Lu, and Sougiannis (2008) report that asymmetric cost behavior is an outcome of managers’ penchant for empire building.

Self-interested managers adjust resources committed to activities to maximize their personal utility, not the value of the firm (Roychowdhury, 2006; Cohen, Dey and Lys, 2008). We examine the impact of current resource adjustments made intentionally to meet earnings targets on the degree of cost stickiness. Findings indicate that managers' choices in adjusting resources that are motivated to avoid losses or earnings decreases diminish sticky costs. Cost stickiness is mitigated in the presence of incentives to meet earnings targets primarily because managers cut resources in response to demand fall at a faster rate than in the absence of these incentives. This result shows that the motivation to meet earnings targets results in deliberate resource adjustments that diminish, rather than induce, sticky costs.

ABJ and Banker, Ciftci and Mashruwala (2008) report that sticky costs occur because managers are slower in making downward resource adjustments than in making upward resource adjustments. These resource adjustments depend on managers' beliefs on future demand, assuming they make optimal decisions to maximize firm value. Focusing on a different motivation, we find that incentives to meet earnings targets result in faster resource adjustments when demand falls than when demand rises; i.e., anti-sticky costs. Therefore, managers' deliberate resource adjustments result in an increase or decrease in the degree of cost stickiness depending on their motivation.

Next, we investigate the effect of technological constraints imposed by technology choices made in advance on cost stickiness. Firms invest in technologies, including production machinery, labor, and knowledge before those resources are actually utilized. Technology choices made in advance set constraints and restrict the firm's ability to respond to activity level changes. These technology choices made to maximize firm value

impose costs of adjustment to demand realizations (Rothschild, 1971). Adjustment costs increase costs of adjusting the activity level upward when demand rises and also decrease savings from adjusting the activity level downward when demand falls, i.e., sticky costs. Accordingly, results indicate that constraints imposed on the firm by technology choices made in advance boost cost stickiness. Particularly, costs exhibit greater stickiness in the presence of hard constraints than in the presence of weak constraints.

The sticky costs model suggested by ABJ recognizes that costs incurred in a current period depend on costs incurred in the previous period and on current beliefs about future demand. We take this approach a step further and document a relationship between costs incurred in a current period and technological constraints set in earlier periods. It is not only previous costs and current beliefs that affect current cost stickiness, but also technology choices made in advance.

Finally, and most interesting, we explore the tension between the two effects that influence cost stickiness. The evidence suggests that cost stickiness imposed by pre-determined technological constraints is wiped out in the presence of incentives to meet earnings targets. Specifically, costs exhibit *symmetric* behavior when incentives to meet earnings targets are introduced, regardless of the level of pre-determined technological constraints. Moreover, incentives to meet earnings targets are shown to be more influential in diminishing cost stickiness under hard technological constraints than under weak technological constraints. Overall, the effect of agency considerations on cost stickiness overcomes the effect of technological constraints. We conclude that resource adjustments encouraged by personal goals influence sticky cost behavior above and beyond those imposed by pre-determined technological constraints.

The contribution of this study is twofold. First, observed symmetric costs are shown to be a consequence of two forces: technology choices made in advance to maximize firm value induce sticky costs on one hand, and current resource adjustments made to meet earnings targets diminish sticky costs on the other hand. Simply said, resources adjustments driven by agency considerations wash away cost stickiness induced by technological constraints. Two different decisions are shown to offset one another, leading to observed symmetric costs. For that reason, inferring the decisions underlying sticky costs from observed costs behavior should be done in light of their motivations. The findings emphasize the importance of understanding the motivations underlying resource adjustments, which result in both symmetric and asymmetric costs.

Second, the findings demonstrate the significant impact of agency-driven incentives on observed sticky costs. The evidence draws attention to a new aspect of prior sticky costs evidence documenting that managerial discretion motivated by profit-maximization considerations influences the degree of cost stickiness (e.g., ABJ; Anderson and Lanen, 2009; Balakrishnan and Gruca, 2008). Ignoring the impact of agency considerations on observed sticky cost behavior may bias the inferences due to an omitted correlated variable problem.

The paper proceeds as follows. Hypotheses are developed in the next section. Section 3 discusses the research design. Section 4 presents the sample selection and descriptive statistics. Section 5 provides the empirical results and Section 6 summarizes.

## 2. *Hypotheses Development*

Understanding how deliberate decisions to adjust resources stem from managers' motivations is a topic of interest to accounting researchers. Particularly, choices to cut resources made by self-interested managers have drawn much attention. Roychowdhury (2006) and Cohen et al. (2008) report that managers reduce costs to avoid losses and earnings decreases. A vast body of evidence indicates that agency considerations lead managers to reduce costs to meet various benchmarks (Dechow and Sloan, 1991; Baber et al., 1991; Bushee, 1998). Yet, the influence of resource adjustments made intentionally to meet earnings targets on the degree of cost stickiness is not known.

Following prior studies, we assume that incentives to meet earnings targets lead managers to accelerate resource cutting to achieve cost savings when demand falls as well as restrain consumption of resources to supply an increasing demand. That is, incentives to meet earnings targets are expected to speed up cost savings when activity level decreases and hold down costs when activity level increases. As a result, cost stickiness is expected to be lessened in the presence of incentives to meet earnings targets.

The argument is illustrated in Figure 1. Suppose a firm produces a single product and  $Y_{t-1}$  is the activity level in period  $t-1$ . For simplicity, we assume that realized activity level in period  $t$  is either low,  $Y_L < Y_{t-1}$ , or high,  $Y_H > Y_{t-1}$ . In the case of low activity level realization and a motivation to meet some earnings target in period  $t$ , managers push hard on cutting resources to increase cost savings and save more than the average cost per unit incurred in period  $t-1$ . Similarly, in the case of high activity level realization and a motivation to meet some earnings target in period  $t$ , managers slow down resource

consumption and produce extra volume at a lower average cost per unit than in period t-1.<sup>2</sup> Deliberate choices in the presence of incentives to meet earnings targets lead managers to speed up downward resource adjustments and slow down upward resource adjustments, which reduce the extent of cost stickiness. The following hypothesis summarizes the argument:

H1: *Resource adjustments made intentionally to meet earnings targets diminish cost stickiness.*

[ Figure 1 about here ]

Firms invest in technologies, including machinery, labor, and knowledge, before these resources are actually utilized. For instance, a technology choice made in advance determines firms' opportunities to respond to a later demand realization. In other words, investment decisions made in prior periods result in technological constraints that restrict the firm's ability to respond to current demand realizations. Weiss and Maher (2009) provide evidence that airlines' early choices in standardized fleets and aircraft ownership afforded improved capabilities to respond to the adverse consequences of the September 11 terrorist attack, resulting in rapid cost adaptability. Tomlin (2006) models means of reducing the detriments of unfavorable demand conditions, which generate cost asymmetry between favorable and unfavorable conditions. Studies on sticky costs report how capacity and functionality affect the degree of observed cost stickiness.

Balakrishnan, Petersen and Soderstrom (2004) use a hospital setting to show that capacity utilization affects cost stickiness. Similarly, Balakrishnan and Gruca (2008) report that

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<sup>2</sup> For brevity, the example presented in Figure 1 assumes, without loss of generality, a linear cost function in period t-1. Incentives to meet earnings mitigate cost stickiness regardless of the degree of cost stickiness in t-1. The same applies to the example presented in Figure 2.



the stickiness of costs is greater for functions that relate to an organization's core competency. The present study, however, investigates the impact of technological constraints imposed on the firm by *past* managerial decisions on the *current* degree of observed cost stickiness.

Searching for a proxy of past technology choices that influence cost stickiness, we take a broad view of technology choices made in advance. Exploring resource adjustments, some technologies afford more capabilities to respond to new demand realizations than others. Technology choices made under uncertainty establish a firm's feasible set of resources, which enables the firm to adjust its activity level in response to unfolding events. Extensive empirical evidence indicates the scale and prevalence of adjustment costs (Hamermesh and Pfann 1996). Galeotti (1990) examines manufacturing firms and reports that, on average, firms' expenditures on adjusting production lines in response to changing circumstances are higher than their investments in new production lines. Bresnahan and Ramey (1994) document how automobile plants adjust their activity levels in response to changing circumstances. They report various types of adjustments, such as adding or dropping a shift, varying hours of operation, and changing line speeds, showing how a moderate change in sales can result in a large change in the adjustment costs.

Prior studies argue that managers choose technologies with low adjustment costs to accommodate high demand uncertainty (Pindyck, 1982). In similar vein, DeGroot (1994) argues that lower adjustment costs better suit business environments characterized by high demand variability. Overall, increased demand uncertainty leads managers to prefer technologies with lower adjustment costs.

Finally, adjustment costs play an important role in shaping sticky cost behavior because the magnitude of adjustment costs influences the asymmetry of observed costs. Greater adjustment costs entail higher costs of adjusting the activity level upward when demand rises but also result in lower savings from adjusting the activity level downward when demand falls. Figure 2 depicts this argument. The figure demonstrates that greater costs of adjustment result in stickier costs. Accordingly, a less flexible technology characterized by higher adjustment costs triggers cost stickiness.

[ Figure 2 about here ]

In sum, lower demand uncertainty results in choosing less flexible technologies with higher adjustment costs, resulting in more sticky costs. We employ demand uncertainty as a proxy for constraints imposed by past technology choices that influence cost stickiness.

H2: *Constraints imposed on the firm by past technology choices made to accommodate lower demand uncertainty result in more sticky costs.*

The hypothesis should not be confused with prior evidence on other aspects of the relationship between uncertainty and firms' cost behavior. First, ABJ and Banker, Ciftci and Mashruwala (2008) show increased cost stickiness when managers evaluate a *current* decline in demand to be temporary. In these two studies, the effect is driven by a *current* decision to maintain resources given some beliefs on future demand. By contrast, we employ demand uncertainty known in a *prior* period to gain insights into how earlier technology choices constrain current adjustments, which result in asymmetric cost behavior. Later in the study we examine the incremental impact of the two separate effects on cost stickiness.

Second, Kallapur and Eldenburg (2005) build on real options theory and use data from Washington state hospitals to test the relationship between uncertainty and the ratio of variable to fixed costs. They report that uncertainty introduced by a change in Medicare reimbursement policy results in managers' choices of technologies with a higher ratio of variable to fixed costs. While Kallapur and Eldenburg (2005) assume a fixed-variable cost model with presumably no sticky costs, we allow for cost stickiness and examine how technology choices made in advance influence the degree of cost stickiness.

There is no reason to believe that the above two hypotheses are independent. Current choices of cutting resources to meet earnings targets depend on technology choices made in advance. For example, an early choice of a technology with high adjustment costs; i.e., hard constraints, is likely to impede managers' ability to adjust resources to meet their earnings targets. In exploring this potential tension, we examine whether current motivation to meet earnings targets impacts the degree of cost stickiness imposed by technological constraints set in advance. The following hypothesis is stated for convenience only and is not an ex ante prediction:

*H3: Incentives to meet earnings targets diminish sticky costs imposed by pre-determined technological constraints.*

### **3. Research Design**

This study explores two potential sources of sticky costs: (1) motivation to meet earnings targets underlying current decisions to adjust resources, (2) technological constraints imposed on the firm by past managerial decisions made to maximize firm value, and (3) their joint effect. Investigating the impact of managerial discretion

motivated by both agency and profit maximization considerations on cost stickiness, we utilize the ABJ framework to test the three hypotheses presented earlier using sub-sample analyses and a comprehensive regression model context.

The ABJ framework measures sticky costs – costs increase more when activity rises than they decrease when activity falls by an equivalent amount. We focus on operating costs to have broad view of technology choices, including manufacturing technologies, distribution technologies, and information technologies. Our approach is consistent with Balakrishnan, Petersen and Soderstrom (2004), Balakrishnan and Gruca (2008) and Weiss (2009). We estimate the ABJ regression model with operating costs (OC): annual sales revenue minus income from operations (Compustat #12 minus Compustat #178). The independent variables are log change of sales revenue (REV), and log change of REV multiplied by an indicator variable that equals 1 if  $REV_{it} < REV_{i,t-1}$  and 0 otherwise ( $REVDEC_{it}$ ). The regression model is:

$$\log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] = \beta_{0t} + \beta_{1t} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \beta_{2t} REVDEC_{it} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \varepsilon_{it} \quad (1)$$

In the ABJ framework, the coefficient  $\beta_1$  measures the level of variable costs,<sup>3</sup> indicating the variation of operating costs with sales revenue. Therefore,  $\beta_1 + \beta_2$  measures the percentage change in operating costs resulting from a 1% decrease in sales revenue. ABJ and a series of subsequent studies report a significantly positive coefficient  $\beta_1$ , and a significantly negative coefficient  $\beta_2$  using various samples and contexts. They claim that a significantly negative coefficient  $\beta_2$  indicates sticky cost behavior. In estimating all the cross-sectional regression models, we exploit

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<sup>3</sup> We use the *level of variable costs* to express the percentage increase in costs with 1% increase in sales revenue (ABJ, p. 52).

potential differences among time periods by computing coefficients and t-statistics for each year as in Fama and MacBeth (1973), reporting mean across-years coefficient estimates and the associated t-statistic.

### 3.1 SUB-SAMPLE ANALYSES

#### 3.1.1 TESTING H1: INCENTIVES TO MEET EARNINGS TARGETS

Testing whether resource adjustments made intentionally to meet earnings targets diminish cost stickiness, we follow Burgstahler and Dichev (1997), Roychowdhury (2006) and Cohen, Dey and Lys (2008) in identifying the presence of such incentives. They argue that firm-years in the interval just right of zero tend to reduce their costs to report income marginally above zero.

Consequently, we group firm-years into intervals based on net income scaled by market capitalization at the beginning of the year. To increase the power of our tests, we concentrate on firm-years in the interval to the immediate right of zero, the suspect firm-years. Following prior studies, we examine a suspect firm-years interval, having net income scaled by market capitalization that is greater than or equal to zero but less than or equal to 0.01. Similarly, we identify incentives to avoid earnings decreases by grouping firm-years into intervals based on changes in net income scaled by market capitalization at the beginning of the year. Again, the interval width is 0.01 and we concentrate on firm-years in the interval to the immediate right of zero, the suspect firm-years. We estimate model (1) for sub-samples of observations with and without incentives to avoid losses and compute mean coefficient estimates across years as in Fama and MacBeth (1973). The estimated coefficients  $\beta_2$  support H1 if  $\beta_2$  is significant and negative absent incentive to meet earnings targets and insignificantly different from

zero (or significant and positive) in the presence of the incentives. Then, we repeat the procedure for sub-samples of observations with and without incentives to avoid earnings decreases.

### 3.1.2 TESTING H2: TECHNOLOGICAL CONSTRAINTS SET IN PRIOR PERIODS

We employ demand uncertainty as a proxy for testing the impact of constraints imposed on the firm by past technology choices made to accommodate greater demand uncertainty on the degree of cost stickiness. The assumption is that higher demand uncertainty results in choosing more flexible technologies with lower adjustment costs, resulting in less sticky costs. Following Aguerrevere (2003), we employ revenue volatility known in a prior period as our proxy of demand uncertainty.<sup>4</sup> Specifically, we use four observations on year  $t-4$  till year  $t-1$  to estimate the variance of sales revenue in a preceding year. Using information available on year  $t-1$  enables estimation of cost behavior implied by technology choices made in advance.  $VREV_{i,t-1}$  is the variance of annual sales revenue of firm  $i$  over the preceding four years  $\{t-4, \dots, t-1\}$ .

We employ VREV to sort the sample into five quintiles according to the level of sales revenue uncertainty. For each year, we rank all firms according to their VREV and assign the sample observations into quintiles. In each quintile, we estimate regression model 1 for each year and compute coefficients and t-statistics as in Fama and MacBeth (1973) by performing annual regressions. H2 predict that a decrease in demand uncertainty in a

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<sup>4</sup> Kallapur and Eldenburg (2005) use a Medicare reimbursement policy change as an event indicator for an industry-specific uncertainty, which cannot be applied in a general context. Empirically investigating the relationship between demand uncertainty and capital investments, Leahy and Whited (1996), Guiso and Parigi (1999), and Bulan (2005) employed variance of daily stock returns as a measure of demand uncertainty. The variance of daily stock returns captures various aspects of uncertainty and is a noisy proxy of demand uncertainty.

prior period results in technology choices that induce more sticky costs.

### 3.1.3 TESTING H3: DO INCENTIVES TO MEET EARNINGS TARGETS DIMINISH STICKY COSTS IMPOSED BY PRE-DETERMINED TECHNOLOGICAL CONSTRAINTS?

Testing H3, we estimate model (1) using four sub-samples. First, we split the sample into two sub-samples of firm-year observations with and without current incentives to avoid losses. Then, we split each sub-sample into observations with hard and weak technological constraints estimated by below median and above median demand uncertainty known on a prior year, respectively. The hypothesis states that sticky costs effects of choices to adjust resources made intentionally to meet earnings targets mitigate the effect of constraints imposed on the firm by past choices. If H3 holds, incentives to avoid losses and to avoid earnings decreases are expected to diminish cost stickiness imposed by pre-determined technological constraints.

## 3.2. COMPREHENSIVE REGRESSION ANALYSES

We extend the ABJ framework to further test the three hypotheses. Rather than employ sub-samples, we estimate comprehensive regression models, which allow for direct tests of multiple effects and interactions between them. We also add control variables used in prior studies. First, ABJ report less sticky costs in periods where revenue also declined in the preceding period. The reason is that managers are likely to consider a revenue decline to be more permanent when it occurs in a second consecutive period of revenue declines, resulting in a motivation to scale down resources. Thus, we

control for successive revenue decreases. Second, adjustment costs tend to be higher when the firm relies more on self-owned assets and employees than on materials and services purchased from external suppliers. Following prior studies (ABJ; Banker, Ciftci, and Mashruwala, 2008), we control for asset intensity and employee intensity.

### 3.2.1 TESTING H1: INCENTIVES TO MEET EARNINGS TARGETS

We estimate the following regression model for testing the impact of both incentives to avoid losses and incentives to avoid earnings decreases on the degree of cost stickiness:

$$\begin{aligned} \log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] &= \beta_{0t} + \gamma_{01t} LOSS_{it} + \gamma_{02t} EDEC_{it} \\ &+ \left\{ \beta_{1t} + \gamma_{11t} LOSS_{it} + \gamma_{12t} EDEC_{it} \right\} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] \\ &+ \left\{ \beta_{2t} + \gamma_{21t} LOSS_{it} + \gamma_{22t} EDEC_{it} \right\} REVDEC_{it} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \text{CONTROLS} + \varepsilon_{it}, \end{aligned} \quad (2)$$

where

$LOSS_{it}$  is an indicator variable that equals 1 if annual earnings deflated by market value at the beginning of the year ( $\text{Compustat \#172}_t / (\text{Compustat \#199}_{t-1} \times \text{Compustat \#25}_{t-1})$ ) is in the interval (0, 0.01), and 0 otherwise.

$EDEC_{it}$  is an indicator variable that equals 1 if the change in annual earnings deflated by market capitalization of shareholders equity at prior year end is in the interval (0, 0.01), and 0 otherwise.

Control variables are as follows:  $SUCDEC_{it}$  is an indicator variable that equals 1 if revenue in year t-1 is less than in year t-2 and 0 otherwise.  $ASSET_{it}$  is a ratio of total assets to sales revenues, and  $EMP_{it}$  is a ratio of the number of employees to sales



revenue.

If incentives to avoid losses and to avoid earnings decreases diminish cost stickiness then we expect  $\gamma_{21}>0$  and  $\gamma_{22}>0$ .

### 3.2.2 TESTING H2: TECHNOLOGICAL CONSTRAINTS SET IN PRIOR PERIODS

Testing H2, we use an indicator variable to facilitate a regression model which differentiates between hard technological constraints and weak technological constraints. In each year, we split the sample into two sub-samples with observations above and below the median value of VREV. We construct DVREV<sub>i,t-1</sub>, an indicator variable that equals 1 if VREV<sub>i,t-1</sub> is above the annual median (weak constraints) and 0 otherwise in year t-1. We employ DVREV to estimate the following regression model:

$$\begin{aligned} \log\left[\frac{OC_{it}}{OC_{i,t-1}}\right] &= \beta_{0t} + \lambda_{0t} DVREV_{i,t-1} \\ &+ \left\{ \beta_{1t} + \lambda_{1t} DVREV_{i,t-1} \right\} \log\left[\frac{REV_{it}}{REV_{i,t-1}}\right] \\ &+ \left\{ \beta_{2t} + \lambda_{2t} DVREV_{i,t-1} \right\} REVDEC_{it} \log\left[\frac{REV_{it}}{REV_{i,t-1}}\right] + \text{CONTROLS} + \varepsilon_{it}. \end{aligned} \quad (3)$$

If H2 holds, weak constraints imposed on the firm by past technology choices made to accommodate greater demand uncertainty result in less sticky costs. Therefore we predict,  $\lambda_2>0$ .

### 3.2.3 TESTING H3: DO INCENTIVES TO MEET EARNINGS TARGETS

DIMINISH STICKY COSTS IMPOSED BY PRE-DETERMINED TECHNOLOGICAL CONSTRAINTS?

Exploring a joint effect of choices to adjust resources made intentionally to meet earnings targets on cost stickiness under hard versus weak constraints, we estimate the following regression model:

$$\begin{aligned}
\log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] &= \beta_{0t} + \gamma_{01t} \text{LOSS}_{it} + \gamma_{02t} \text{EDEC}_{it} + \lambda_{0t} \text{DVREV}_{i,t-1} \\
&+ \left\{ \beta_{1t} + \gamma_{11t} \text{LOSS}_{it} + \gamma_{12t} \text{EDEC}_{it} + \lambda_{1t} \text{DVREV}_{i,t-1} + \eta_{11t} \text{LOSS}_{it} \text{DVREV}_{i,t-1} + \eta_{12t} \text{EDEC}_{it} \text{DVREV}_{i,t-1} \right\} \log \left[ \frac{\text{REV}_{it}}{\text{REV}_{i,t-1}} \right] \\
&+ \left\{ \beta_{2t} + \gamma_{21t} \text{LOSS}_{it} + \gamma_{22t} \text{EDEC}_{it} + \lambda_{2t} \text{DVREV}_{i,t-1} + \eta_{21t} \text{LOSS}_{it} \text{DVREV}_{i,t-1} + \eta_{22t} \text{EDEC}_{it} \text{DVREV}_{i,t-1} \right\} \text{REVDEC}_{it} \log \left[ \frac{\text{REV}_{it}}{\text{REV}_{i,t-1}} \right] \\
&+ \text{CONTROLS} + \epsilon_{it}.
\end{aligned} \tag{4}$$

If choices to adjust resources made to avoid losses (earnings decreases) diminish cost stickiness imposed by hard technological constraints set in advance then

$\gamma_{21} > 0$  ( $\gamma_{22} > 0$ ). Similarly, for the case of weak technological constraints, H3 predicts

$\gamma_{21} + \eta_{21} > 0$  ( $\gamma_{22} + \eta_{22} > 0$ ).

#### 4. *Sample Selection and Descriptive Statistics*

The sample includes all public firms covered by Compustat and CRSP during 1979-2006. We follow Burgstahler and Dichev [1997], ABJ and Roychowdhury [2006] in using annual data for our tests. We exclude financial institutions and public utilities (4-digit SIC codes 6000-6999 and 4900-4999) because the structure of their financial statements is incompatible with those of other companies. The sample includes firm-year observations with positive values for sales revenue, total assets, book value, and market value. We also require share price at fiscal year end to be greater than \$1 and delete firm-year observations with missing data on two preceding years (t-1, t-2).

To limit the effect of extreme observations, each year we rank the sample according to the variables in the regression models and remove the extreme 0.5 percent of the

observations on each side. The sample includes 97,547 firm-year observations for 11,758 different firms. Table 1 provides details on the sample selection.<sup>5</sup>

[ Table 1 about here ]

Comparing the descriptive statistics of our sample reported in table 2 with the ABJ sample, the firms in our sample are larger due to differences in sampling criteria (mean sales of \$1,809 million compared to \$1,277 million in ABJ). Yet, our sample shows similar frequency of sales declines (27.4% versus 27.0% in ABJ). Table 2 also presents descriptive statistics of the incentive dummy variables. There are 3,216 suspect firm-years (3.3% of the sample) with incentives to avoid losses and 9,409 suspect firm-years (9.7% of the sample) with incentives to avoid earnings decreases.

[ Table 2 about here ]

## 5. *Empirical Results*

### 5.1 SUB-SAMPLE ANALYSES

H1 predicts less sticky costs (higher value of  $\beta_2$ ) caused by resource adjustments made intentionally to meet earnings targets. Testing the hypothesis, results from estimating model 1 (ABJ) in sub-samples of observations with and without incentives to meet earnings targets are reported in table 3. Given no incentives to avoid losses, the mean value of  $\beta_2$  is -0.1008, significantly different from zero at the 0.01 level (see Panel A). That is, costs are sticky when managers are not motivated to avoid losses, consistent

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<sup>5</sup> Anderson and Lanen (2009) argue that cost stickiness should be conditional on the assumption that costs move in the same direction as sales revenue. Following their argument, we also use sample selection criteria in which we delete observations with costs moving in an opposite direction to revenues. The empirical results (not reported) are qualitatively similar.

with ABJ's findings. However, the mean value of  $\beta_2$  in the presence of incentives to avoid losses is 0.0610, insignificantly different from zero (see Panel A). That is, costs exhibit a symmetric pattern, not sticky, when managers are motivated to avoid losses, in contrast with ABJ's findings. The cost stickiness is washed away in the presence of incentives to avoid losses, in support of H1.

Similarly, given no incentives to avoid earnings decreases, the mean value of  $\beta_2$  is -0.1014, significantly different from zero at the 0.01 level (see Panel B). Again, this result is consistent with ABJ's findings. However, the mean value of  $\beta_2$  in the presence of incentives to avoid earnings decreases is 0.0235, insignificantly different from zero. Once more, cost stickiness is washed away in the presence of incentives to avoid earnings decreases, in line with H1.

Absent incentives to meet earnings targets, managers adjust resources downwards at a slower rate than they adjust them upwards, resulting in sticky costs. The introduction of these incentives changes the pattern to symmetric costs. Overall, the findings support H1 and indicate that incentives to meet earnings targets diminish cost stickiness, resulting in symmetric costs.

[ Table 3 about here ]

Next, results from investigating the relationship between pre-determined technological constraints and cost stickiness are presented in table 4. Employing demand uncertainty as a proxy for technological constraints imposed by past choices, we estimate model 1 (ABJ) in five quintiles that are sorted according to the level of demand uncertainty, VREV. The mean sticky costs measure,  $\beta_2$ , increases monotonically from -0.1773, significantly different from zero at the 0.01 level, in the quintile with the hardest

constraints, to -0.0374, insignificantly different from zero, in the quintile with the weakest constraints. The difference in the estimated sticky costs measure between these quintiles is 0.1399, significantly different from zero at the 0.01 level. While operating costs exhibit some stickiness in four of the five quintiles, the cost stickiness is insignificantly different from zero in the weakest constraints quintile. The results support H2 and suggest that technology choices made to accommodate high demand uncertainty lessen cost stickiness.

Interestingly, from table 4 we see that the mean values of coefficient estimates for  $\beta_1$  (the percentage increase in operating costs with a 1% increase in sales revenue) are monotonically increasing from 0.6315 to 0.9554, both highly significant. The difference between these mean coefficients is 0.3239, significantly different from zero at the 0.01 level. The findings suggest that increased demand uncertainty leads managers to prefer technologies with a higher level of variable costs.<sup>6</sup> This evidence corroborates results reported by Kallapur and Eldenburg (2005) and expands our understanding of how managers react to their environment and the repercussions on cost behavior. Kallapur and Eldenburg (2005) show that uncertainty introduced by a change in Medicare reimbursement policy leads managers to prefer technologies with low fixed and high variable costs. Their study assumes a symmetric fixed-variable cost model. Allowing for adjustment costs to extend the context of the analysis with asymmetric cost behavior, we find that technology choices under high uncertainty result in low cost stickiness.

Moreover, this study generalizes Kallapur and Eldenburg's (2005) findings by employing

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<sup>6</sup> The percentage increase in variable costs ( $\beta_1$ ) should not be confused with its asymmetry ( $\beta_2$ ). A high level of variable costs, 0.95, is accompanied by symmetric costs in the highest demand uncertainty quintile (see Table 4). This finding is meaningful because a high level of variable costs provides much room for potential cost asymmetry.

a broad measure of demand uncertainty in a large sample.

[ Table 4 about here ]

Testing H3, we estimate the impact of resource adjustments made intentionally to avoid losses (earnings decreases) on the degree of cost stickiness in the presence of technological constraints set in advance. In each year, we split the sample into sub-samples with hard and weak technological constraints using  $DVREV_{it}$  and then split each sub-sample into observations with and without incentives to avoid losses (avoid earnings decreases) using  $LOSS_{it}$  ( $EDEC_{it}$ ).

Mean coefficient estimates for  $\beta_2$  from estimating model 1 (ABJ) in each of the four sub-samples are reported in table 5. Figures reported in panel A indicate that the degree of cost stickiness,  $\beta_2$ , for sub-samples without incentives to avoid losses and hard (weak) technological constraints, is -0.1274 (-0.0620), both significantly negative at the 0.01 level. However, the degree of cost stickiness for sub-samples with incentives to avoid losses and hard (weak) technological constraints is -0.0119 (0.0238), both insignificantly different from zero. The findings indicate significant sticky cost behavior when no incentives to avoid losses are present, but symmetric costs when incentives to avoid losses are introduced. Results reported in Panel B also indicate significant sticky costs absent incentives to avoid earnings decreases, and symmetric costs when incentives to avoid earnings decreases are introduced. The findings demonstrate that managers' resource adjustments are influenced by incentives to meet earnings targets under both hard and weak technological constraints. Consistent with H3, the evidence suggests that cost stickiness imposed by pre-determined technological constraints is washed away in the presence of incentives to meet earnings targets.

[ Table 5 about here ]

The results offer another noteworthy insight on the differential impact of the agency considerations on cost stickiness given hard versus weak pre-determined technological constraints. Absent agency considerations, costs exhibit greater stickiness in the presence of hard constraints than in the presence of weak constraints. Specifically, the difference in  $\beta_2$  for sub-samples without incentives to avoid losses (avoid earnings decreases) is  $-0.0620 - -0.1274 = 0.0654$ ,  $(-0.0584 - -0.1277 = 0.0693)$ , both significant at least at the 0.05 level. This result supports H2 and is in line with evidence reported in table 4. However, this pattern does not hold in the presence of incentives to meet earnings targets. Costs exhibit symmetric behavior given either incentives to avoid losses or incentives to avoid earnings decreases, regardless of the technological constraints. We conclude that resource adjustments encouraged by personal goals influence cost behavior above and beyond those imposed by pre-determined technological constraints. Overall, the effect of agency considerations on the degree of cost stickiness overcomes the effect of technological constraints.

## 5.2 COMPREHENSIVE REGRESSION ANALYSES

We estimate comprehensive regression models to further corroborate the evidence. We start by estimating the ABJ model with controls. Results reported in table 6 (Reg 1) indicate that the mean value of  $\beta_1$  is 0.7746, positive and significantly different from zero at the 0.01 level, and the mean value of  $\beta_2$  is -0.0924, negative and significantly different from zero at the 0.01 level. The results are consistent with prior studies (Weiss, 2009), indicating that operating costs are, on average, sticky.

[ Table 6 about here ]

Next, we estimate regression model 2 to test the effect of both incentives to avoid losses and to avoid earnings decreases. The mean value of  $\beta_2$  is -0.0973, significantly different from zero at the 0.01 level. The mean coefficient  $\gamma_{21}$  ( $\gamma_{22}$ ) is 0.1364, (0.1439), positive and significantly different from zero at the 0.01 (0.02) level, indicating less sticky costs. The findings suggest that incentives to avoid losses and to avoid earnings decreases result in resource adjustments that make costs less sticky. As before, the findings support H1.

Checking the sensitivity of the findings, we employed an alternative earnings deflator. Durtschi and Easton (2005) investigate distributions of scaled earnings and report differences between the shape of the distribution of earnings scaled by total assets and the shape of the distribution of earnings scaled by market capitalization. Therefore, we computed the intervals of suspect firm-years with earnings scaled by total assets (rather than market capitalization) and replicated the analyses. In addition, we replicated the analyses using different intervals sizes of (0, 0.005) and (0, 0.02). The results (not reported for brevity) remain essentially the same.

Overall, the results support H1 by showing that incentive to meet earnings targets result in resource adjustments that wash away sticky cost behavior. The results support meaningful evidence that the extent of sticky costs is at least partly driven by managers' intentional choices motivated by agency considerations.

Testing H2, results from estimating regression model 3 are presented in table 6. The mean effect of weak pre-determined technological constraints proxied by high (above median) demand uncertainty on the degree of cost stickiness is  $\lambda_2=0.0485$ , significant at



the 0.06 level. Thus, more flexible technologies featuring low adjustment costs, which impose weak constraints on firms, induce anti-sticky costs. The findings support H2.

Checking the sensitivity of the results to the proposed demand uncertainty measure, we estimate regression model 3 employing two alternative demand uncertainty measures. We use (i) VREV deflated by average sales revenue, and (ii) the variation of deflated sales revenue (by market value of equity). The results are essentially the same and confirm the findings. Additionally, we replicate the estimations when the indicator variable DVREV equals 1 if  $VREV_{i,t-1}$  is in the highest quintile and 0 otherwise. Again, the results are essentially the same and consistent with H2.

Employing a comprehensive model for further testing all three hypotheses, we estimate regression model 4 and report the results in table 6. The findings confirm H1, indicating that each of the two incentives to meet earnings targets have an incremental effect on the degree of cost stickiness ( $\gamma_{21}=0.1667$ ,  $p=0.03$ ;  $\gamma_{22}=0.2145$ ,  $p=0.01$ ). In similar vein, we find a significant incremental effect of pre-determined technological constraints on the degree of cost stickiness ( $\lambda_2=0.0507$ ,  $p=0.06$ ), in line with H2.<sup>7</sup>

The results draw attention to another subtle insight. Recalling the mean coefficient estimates for regression model 4, the incremental direct cost effect in the presence of incentives to avoid losses (avoid earnings decreases) is  $\gamma_{11}=0.0568$  ( $\gamma_{12}=0.0340$ ), both insignificantly different from zero. That is, managers do not restrain costs in the presence of incentives to meet earnings targets and demand rise. In contrast, managers accelerate resource cuts in the presence of incentives to avoid losses (avoid earnings decreases) and

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<sup>7</sup> As before, we find that high demand uncertainty leads firms to prefer technologies with high variable costs. Specifically, the coefficient estimate  $\lambda_1=0.2190$  is positive and significantly different from zero at the 0.01 level. This result is consistent with Kallapur and Eldenburg (2005).

demand fall,  $\gamma_{21}=0.1667$ ,  $p=0.03$  ( $\gamma_{22}=0.2145$ ,  $p=0.01$ ). This result suggests that incentives lead managers to expedite resource adjustments made intentionally to meet some earnings targets only when demand falls.

To gain clear insights regarding H3, we present an interpretation of the mean sticky coefficient estimates of regression model 4 in table 7. Looking at incentives to avoid losses (see panel A), the degree of cost stickiness absent agency considerations is  $-0.1214$  ( $p=0.01$ ) for hard technological constraints and  $-0.0707$  ( $p=0.04$ ) for weak technological constraints. That is, costs exhibit significant stickiness with no incentives to avoid losses given either hard or weak constraints. However, introducing incentives to avoid losses leads to resource adjustments that wipe out cost stickiness, resulting in symmetric costs:  $0.0453$  for hard technological constraints and  $-0.0410$  for weak technological constraints, both insignificantly different from zero at the 0.10 level. Results reported in panel B for incentives to avoid earning decreases indicate a similar pattern. These results further corroborate the evidence in support of H3. The effect of motivation to meet earnings targets on the degree of cost stickiness overcomes the effect of (hard or weak) technological constraints.

We also examine the differential effect of incentives to meet earnings targets on cost stickiness given hard versus weak technological constraints. Cost stickiness in the presence of incentives to avoid losses is mitigated (a less negative coefficient) more under hard constraints than under weak constraints,  $\eta_{21}=-0.1370$  ( $p=0.09$ ) – see panel A. Similarly, cost stickiness in the presence of incentives to avoid losses is reduced (a less negative coefficient) more under hard constraints than under weak constraints,  $\eta_{22}=-0.1161$  ( $p=0.06$ ) – see panel B. The reduction in the degree of cost stickiness

triggered by incentives to meet earnings targets is different for hard and weak technological constraints. Incentives to meet earnings targets are more influential in diminishing cost stickiness under hard technological constraints than under weak technological constraints.

[ Table 7 about here ]

Results with respect to the control variables are in line with prior studies. Mean coefficient estimates with respect to successive decreases in sales revenue, asset intensity and employee intensity are positive and significant across all regressions. The results demonstrate that the effects of both pre-determined constraints and incentives to meet earnings targets on sticky costs hold when controlled for determinants of sticky costs reported in the literature.<sup>8</sup>

In sum, the evidence shows that incentives to meet earnings targets as well as technological constraints incrementally and jointly affect sticky cost behavior. These effects are economically meaningful and statistically significant. The findings extend the literature by showing how decision to adjust resources made by self-interested managers in the presence of incentives to avoid losses and earning decreases diminish sticky costs induced by technology choices made in advance. On the whole, resource adjustments motivated by personal interests influence observed sticky cost behavior above and beyond those imposed by technology choices made in advance.

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<sup>8</sup> Further investigating the robustness of the results, we control for potential industry-specific effects using Kenneth French's 12-industry classification, [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). Findings indicate that the results are not driven by industry-specific effects.

## 6. *Summary*

In this study we show that both incentives to meet earnings targets and technology choices made to accommodate demand uncertainty affect sticky cost behavior. Results indicate that incentives to avoid losses and incentives to avoid earnings decreases result in resource adjustments that diminish cost stickiness. Yet, increased demand uncertainty motivates managers to choose more flexible technologies with lower adjustment costs, and hence less sticky costs. Combining the two effects, we find that managers' deliberate choices motivated to meet earnings targets overcome pre-determined technological constraints. Overall, our results provide insights that are useful for the management accounting literature and encourage further research to enhance our understanding of the role of motivations underlying managers' decisions in shaping cost behavior.

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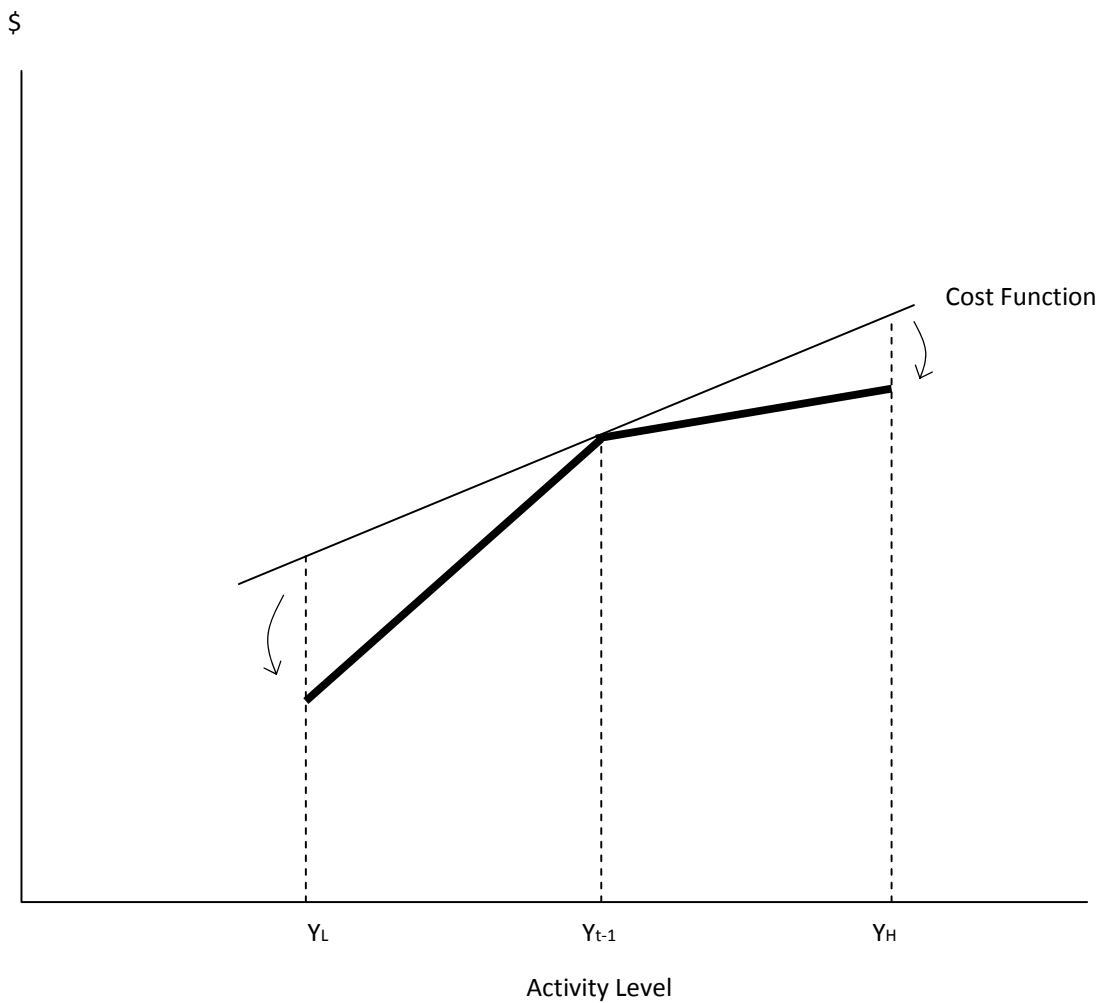
WEISS, D., and M.W. MAHER. 2009. "Operational Hedging against Adverse Circumstances." *Journal of Operations Management* 27: 362-373.



**FIGURE 1**

**Incentives to meet earnings targets reduce the degree of cost stickiness**

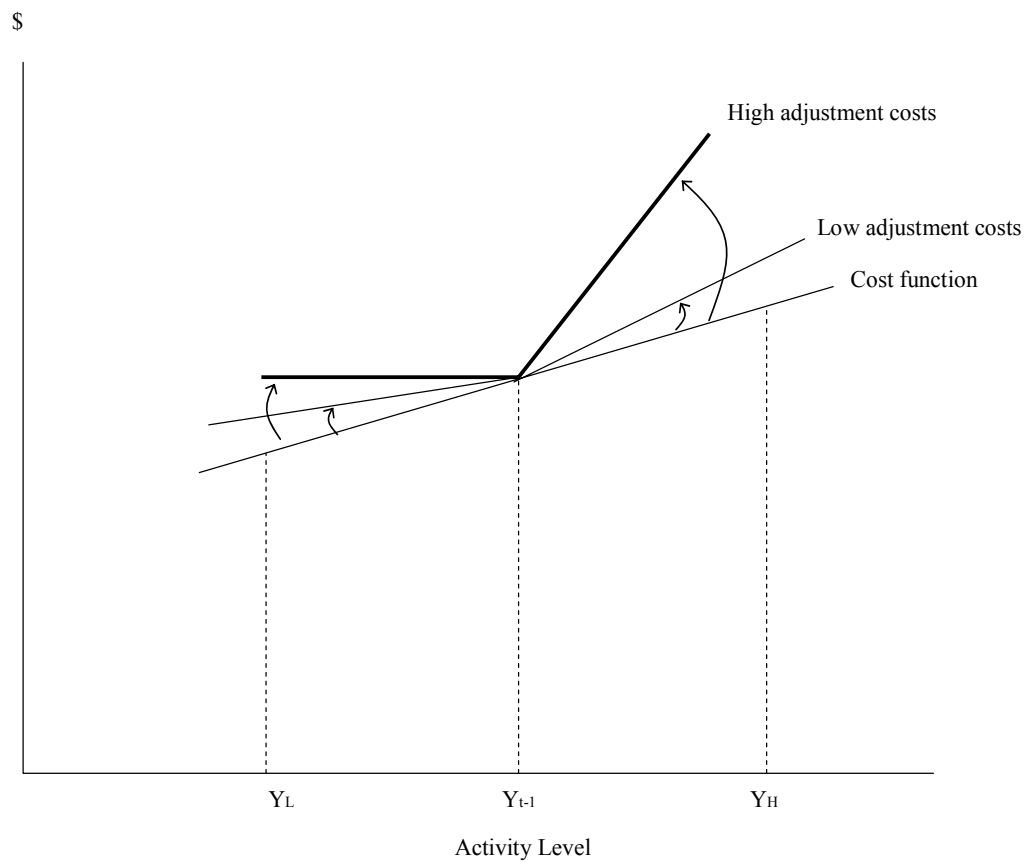
The figure illustrates resource adjustments in the presence of incentives to meet earnings targets. If the realized activity level is low,  $Y_L$ , then managers accelerate cost savings, indicated by the steeper bold curve. If the realized activity level is high,  $Y_H$ , then managers slow down resource consumption, indicated by the less steep bold curve. While the original curve is linear (symmetric costs), the bold curve exhibits anti-sticky costs.



**FIGURE 2**

**Greater adjustment costs increase the degree of cost stickiness**

The figure indicates that higher adjustment costs entail higher costs of adjusting the activity level upward and also result in lower savings from adjusting the activity level downward. Higher cost of adjustments results in stickier costs.



**TABLE 1**  
*Sample Selection\**

Sample	Observations deleted	Observations remaining	Different firms
Initial sample: Firm-year observations with valid data on Compustat, 1979-2006		135,594	16,149
Excluding observations with share price below 1\$	14,078	121,516	15,158
Excluding observations with missing data on two preceding years (t-1, t-2)	22,565	98,951	11,844
Excluding observations that exhibit extreme values for the regression variables (i.e., in the top and bottom 0.5% of the distribution)	1,404	<b>97,547</b>	<b>11,758</b>

\*Note: The initial sample includes all firms with complete financial data available on Compustat on sales revenue (Compustat #12), operating income (Compustat #178), net earnings (Compustat #172), total assets (Compustat #6), book value (Compustat #60) and market value (Compustat #25\*Compustat#199). We exclude financial institutions (one-digit SIC = 6) and public utilities (two-digit SIC = 49).

**TABLE 2**  
*Descriptive Statistics\**

<u>Variable</u>	<u>Mean</u>	<u>Std. Deviation</u>	<u>25<sup>th</sup> Pctl</u>	<u>Median</u>	<u>75<sup>th</sup> Pctl</u>
<b>REV</b>	1,809.36	8,386.62	39.74	159.56	717.95
<b>OC</b>	1,635.93	7,660.57	39.44	147.44	653.85
<b>MV</b>	2,041.80	12,678.29	28.95	121.08	632.11
<b>REVDEC</b>	0.2744	0.4462	0	0	1
<b>LOSS</b>	0.0330	0.1786	0	0	0
<b>EDEC</b>	0.0965	0.2952	0	0	0

\*Definitions of variables:

**REV<sub>it</sub>** – annual sales revenue (Compustat #12) of firm i in year t,

**OC<sub>it</sub>** – operating costs of firm i in year t – annual sales revenue minus income from operations (Compustat #12 minus Compustat #178),

**MV<sub>it</sub>** – market capitalization of shareholders equity at year t end (Compustat #199 X Compustat #25),

**REVDEC<sub>it</sub>** – a dummy variable that equals 1 if  $REV_{it} < REV_{i,t-1}$  and 0 otherwise,

**LOSS<sub>it</sub>** – a dummy variable that equals 1 if annual earnings deflated by market capitalization of shareholders equity at prior year end ( $Compustat\ #172_t / MV_{t-1}$ ) is in the interval  $[0, 0.01]$ , and 0 otherwise,

**EDEC<sub>it</sub>** – a dummy variable that equals 1 if the change in annual earnings deflated by market capitalization of shareholders equity at prior year end is in the interval  $[0, 0.01]$ , and 0 otherwise.

The sample includes 97,547 firm year observations, 1979-2006.

**TABLE 3*****The Impact of Incentives to Meet Earnings Targets on the Degree of Cost Stickiness\****

## Panel A - Avoid losses

	$\beta_0$	$\beta_1$	$\beta_2$
Avoid losses LOSS=1 N = 3,216	0.0265*** (8.05)	0.7796*** (37.14)	0.0610 (1.37)
LOSS = 0 N = 94,331	0.0255*** (11.31)	0.7175*** (32.24)	-0.1008*** (-4.64)

## Panel B - Avoid Earnings Decreases

	$\beta_0$	$\beta_1$	$\beta_2$
Avoid earnings decreases EDEC =1 N = 9,409	0.0238*** (5.24)	0.7562*** (18.34)	0.0235 (0.31)
EDEC = 0 N = 88,138	0.0252*** (11.33)	0.7189*** (33.98)	-0.1014*** (-4.77)

\*Notes:

1. The table presents regression results for sub-samples of observations with and without incentives to meet earnings targets. We split the sample into observations with and without incentives to avoid losses (panel A) and with and without incentives to avoid earnings decreases (panel B). Then we estimate regression 1 separately in each of the sub-samples, for each year as in Fama and MacBeth (1973). The table presents mean values of coefficients  $\beta_2$  and the associated t-statistics (in parentheses) for each sub-sample.

$$\log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] = \beta_{0t} + \beta_{1t} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \beta_{2t} REVDEC_{it} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \varepsilon_{it} \quad (1)$$

2. See table 2 for definitions of variables.

3. \*, \*\*, \*\*\* – denote significance at the 0.10, 0.05 and 0.01 levels, respectively.

**TABLE 4**  
*The Impact of Technological Constraints Determined in Past Periods on the Degree of Cost Stickiness\**

Technological constraints Quintiles	$\beta_0$	$\beta_1$	$\beta_2$
1 – Hard constraints (Low demand uncertainty)	0.0228***	0.6315***	-0.1773***
2	0.0133***	0.8191***	-0.1275***
3	0.0114***	0.8773***	-0.0827***
4	0.0087***	0.9221***	-0.0627***
5 – Weak constraints (High demand uncertainty)	0.0040***	0.9554***	-0.0374
5-1	-0.0188***	0.3239***	0.1399***

\*Notes:

1. The table presents regression results for quintiles assigned according to demand uncertainty level (VREV) estimated in year t-1.  $VREV_{i,t-1}$  is the variance of annual sales revenue of firm i over the preceding four years  $\{t-4, \dots, t-1\}$ . For each year, we sorted all firms according to their VREV and assigned the sample observations to quintiles. We estimate regression 1 for each quintile as in Fama-MacBeth.

$$\log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] = \beta_{0t} + \beta_{1t} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \beta_{2t} REVDEC_{it} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \varepsilon_{it} \quad (1)$$

2. See table 2 for definitions of variables.
3. \*, \*\*, \*\*\* – denote significance of difference from zero at the 0.10, 0.05 and 0.01 levels, respectively.
4. The average number of observations in each quintile is 16,160.

**TABLE 5**

*The Impact of Incentives to Meet Earnings Targets on the Degree of Cost Stickiness in the Presence of Hard versus Weak Technological Constraints\**

Panel A – Incentives to Avoid Losses

	Hard technological constraints (Low demand uncertainty)	Weak technological constraints (High demand uncertainty)
Avoid losses LOSS=1 N = 2,418	-0.0119 (-0.17)	0.0238 (0.36)
LOSS = 0 N = 76,021	-0.1274*** (-5.59)	-0.0620*** (-3.69)

Panel B – Incentives to Avoid Earnings Decreases

	Hard technological constraints (Low demand uncertainty)	Weak technological constraints (High demand uncertainty)
Avoid earnings decrease EDEC =1 N = 7,787	0.0797 (1.12)	-0.0101 (-0.31)
EDEC = 0 N = 70,652	-0.1277*** (-5.75)	-0.0584*** (-3.37)

\*Notes

1. We split our sample into four sub-samples. First, we use demand uncertainty in the preceding year ( $VREV_{t-1}$ ) to sort the sample into low versus high demand uncertainty. Then, we sort each of the two sub-samples into observations with and without incentives to avoid losses (Panel A) and with and without incentives to avoid earnings decreases (Panel B). We estimate regression 1 separately in each of the four sub-samples, for each year as in Fama and

MacBeth (1973). The table presents mean values of coefficients  $\beta_2$  and the associated t-statistics (in parentheses).

$$\log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] = \beta_{0t} + \beta_{1t} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \beta_{2t} REVDEC_{it} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] + \varepsilon_{it} \quad (1)$$

2. Demand uncertainty is defined as high (low) if  $VREV_{i,t-1}$  is above (below) the annual median in each year.  $VREV_{i,t-1}$  is the variance of annual sales revenue of firm  $i$  over the preceding four years  $\{t-4, \dots, t-1\}$ . See table 2 for definitions of other variables.
3. \*, \*\*, \*\*\* – denote significance of difference from zero at the 0.10, 0.05 and 0.01 levels, respectively.
4. The number of observations is determined by data availability for all variables.



**TABLE 6**  
*Comprehensive Regression Analyses\**

Coefficient	Prediction	Reg 1	Reg 2	Reg 3	Reg 4
		ABJ	Earnings Targets	Technological Constraints	Comprehensive Analysis
<u>Intercepts</u>					
$\beta_0$		0.0376*** (4.74)	0.0368*** (4.82)	0.0413*** (4.83)	0.0407*** (4.84)
$\gamma_{01}$			0.0058 (1.21)		0.0059 (1.32)
$\gamma_{02}$			-0.0030 (-1.00)		-0.0050** (-2.21)
$\lambda_0$				-0.0125*** (-5.28)	-0.0129*** (-5.48)
<u>Direct effect</u>					
$\beta_1$		0.7746*** (37.95)	0.7714*** (37.29)	0.7046*** (27.94)	0.7018*** (27.54)
$\gamma_{11}$			0.0298 (0.89)		0.0568 (1.49)
$\gamma_{12}$			0.0618*** (2.73)		0.0340 (1.29)
$\lambda_1$				0.2204*** (10.43)	0.2190*** (10.31)
$\eta_{11}$					-0.0904** (-2.19)
$\eta_{12}$					0.0559** (2.62)
<u>Sticky measures</u>					
$\beta_2$	ABJ: $\beta_2 < 0$	-0.0924*** (-4.90)	-0.0973*** (-5.10)	-0.1176*** (-5.40)	-0.1214*** (-5.37)
$\gamma_{21}$	H1: $\gamma_{21} > 0$		0.1364*** (2.66)		0.1667** (2.41)
$\gamma_{22}$	H1: $\gamma_{22} > 0$		0.1439** (2.48)		0.2145*** (3.17)
$\lambda_2$	H2: $\lambda_2 > 0$			0.0485* (1.94)	0.0507* (1.99)
$\eta_{21}$					-0.1370* (-1.72)
$\eta_{22}$					-0.1161* (-1.96)
<u>Control variables</u>					
Successive decrease		0.0477** (2.28)	0.0496** (2.35)	0.0627*** (3.34)	0.0634*** (3.27)
Asset intensity		0.0141*** (5.23)	0.0140*** (5.17)	0.0143*** (5.27)	0.0142*** (5.16)
Employee intensity		0.0035** (2.06)	0.0033* (2.03)	0.0037* (2.00)	0.0035* (1.94)
Adj-R <sup>2</sup>		0.7226	0.7243	0.7440	0.7474
N		78,439	78,439	78,439	78,439

\*Notes:

1. The table presents mean coefficients and the associated t-statistics (in parentheses) for the following yearly cross-sectional Fama-MacBeth regression models:

$$\begin{aligned} \log \left[ \frac{OC_{it}}{OC_{i,t-1}} \right] &= \beta_{0t} + \gamma_{01t} LOSS_{it} + \gamma_{02t} EDEC_{it} + \lambda_{0t} DVREV_{i,t-1} \\ &+ \left\{ \beta_{1t} + \gamma_{11t} LOSS_{it} + \gamma_{12t} EDEC_{it} + \lambda_{1t} DVREV_{i,t-1} + \eta_{11t} LOSS_{it} DVREV_{i,t-1} + \eta_{12t} EDEC_{it} DVREV_{i,t-1} \right\} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] \\ &+ \left\{ \beta_{2t} + \gamma_{21t} LOSS_{it} + \gamma_{22t} EDEC_{it} + \lambda_{2t} DVREV_{i,t-1} + \eta_{21t} LOSS_{it} DVREV_{i,t-1} + \eta_{22t} EDEC_{it} DVREV_{i,t-1} \right\} REVDEC_{it} \log \left[ \frac{REV_{it}}{REV_{i,t-1}} \right] \\ &+ CONTROLS + \varepsilon_{it}, \end{aligned}$$

2.  $DVREV_{i,t-1}$  is a dummy variable that equals 1 if  $VREV_{i,t-1}$  (demand uncertainty in the preceding year) is above the annual median and 0 otherwise. See table 2 for definitions of other variables.
3. \*, \*\*, \*\*\* – denote significance of difference from zero at the 0.10, 0.05 and 0.01 levels, respectively.
4. The number of observations for all four regressions is determined by data availability for all variables.

**TABLE 7**  
**Testing H3 - Interpretation of Coefficient Estimates (Regression 4 in Table 6)\***

Panel A – The impact of incentives to avoid losses on the degree of cost stickiness in the presence of hard versus weak technological constraints.

Degree of stickiness		Hard technological constraints (Low demand uncertainty)	Weak technological constraints (High demand uncertainty)
Stickiness measure	$\beta_2$	-0.1214***	-0.1214***
Weak technological constraints effect	$\lambda_2$	_____	<u>0.0507*</u>
Stickiness without incentives to avoid losses		<b>-0.1214***</b>	<b>-0.0707**</b>
Incentives to avoid losses	$\gamma_{21}$	0.1667**	0.1667**
Interaction	$\eta_{21}$	_____	<u>-0.1370*</u>
Stickiness with incentives to avoid losses		<b>0.0453</b>	<b>-0.0410</b>

Panel B – The impact of incentives to avoid earnings decreases on the degree of cost stickiness in the presence of hard versus weak technological constraints.

Degree of stickiness		Hard technological constraints (Low demand uncertainty)	Weak technological constraints (High demand uncertainty)
Stickiness measure	$\beta_2$	-0.1214***	-0.1214***
Weak technological constraints effect	$\lambda_2$	_____	<u>0.0507*</u>
Stickiness without incentives to avoid earnings decreases		<b>-0.1214***</b>	<b>-0.0707**</b>
Incentives to avoid earnings decreases	$\gamma_{22}$	0.2145***	0.2145***
Interaction	$\eta_{22}$	_____	<u>-0.1161*</u>
Stickiness with incentives to avoid earnings decreases		<b>0.0931</b>	<b>0.0277</b>

\*Notes:

1. The table presents an interpretation of the results reported for regression 4 in table 6.
2. \*, \*\*, \*\*\* – denote significance of difference from zero at the 0.10, 0.05 and 0.01 levels, respectively.