Asymmetries in Cost-Volume-Profit Relation:
Cost Stickiness and Conditional Conservatism

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Abstract

Cost-volume-profit (CVP) analysis is based on a linear model of earnings behavior. However, recent research documents two potential sources of asymmetry in earnings: cost stickiness and conditional conservatism. We examine the implications of these asymmetries for CVP analysis and develop an "asymmetric CVP" (ACVP) framework incorporating both phenomena. ACVP estimates for Compustat/CRSP data reveal dramatic deviations from the standard CVP model (attributed to both stickiness and conservatism). These asymmetric deviations lead to major conceptual revisions in CVP analysis and have a large impact on various CVP benchmarks.

Keywords: resource adjustment costs, breakeven analysis, budgeting, managerial discretion.
JEL codes: C5; D2; L2; L23; M4; M46

1. Introduction

Cost-volume-profit (CVP) analysis is one of the most widely used tools in management accounting, which serves multiple purposes both internally (such as evaluating alternative sales scenarios, budgeting and performance evaluation) and externally (such as earnings forecasts conditional on sales forecasts by investors and analysts). The CVP relation is based on the standard model of fixed and variable costs, which implies a linear relation between sales and costs, and therefore, between sales and earnings. However, recent studies document two important non-linearities in cost and earnings behavior: cost stickiness – an economic asymmetry in the response of costs to sales increases versus decreases (e.g., Anderson et al. 2003, henceforth ABJ), and conditional conservatism – a financial reporting asymmetry in the recognition of good versus bad news (e.g., Basu 1997). We argue that the prevalence of these phenomena calls for two important modifications in CVP-type analysis. First, cost stickiness requires significant conceptual changes in many of the standard applications of CVP. Second, both cost stickiness and conditional conservatism are likely to distort cost structure estimates that enter CVP analysis, leading to systematic biases in inferences drawn from CVP. Therefore, we develop modified CVP models, which incorporate both stickiness and conservatism, and which directly address both the conceptual and the empirical limitations of standard CVP.

Studies such as ABJ and Weiss (2010) show that many costs rise more when sales increase than they fall when sales decrease, which conflicts with the linear change assumption of CVP. ABJ argue that cost stickiness reflects asymmetries in managers' resource commitment decisions. When sales decrease, managers retain unused resources to avoid incurring resource adjustment costs such as severance pay or losses on disposal of equipment. Therefore, costs fall less in response to a sales decrease than they rise for an equal sales increase. To incorporate cost

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stickiness in the CVP analysis, we translate the main predictions from the extant literature, which are formulated in terms of *changes* in sales and costs, into new predictions for the *levels* of sales and costs. We predict that for the same realized sales level, costs are higher if this sales level represents a decrease relative to prior period sales. Consequently, earnings are higher if sales expanded rather than contracted to the same level. The "sticky earnings differential" between the two earnings levels reflects slack resources retained by managers when sales decrease.

This theoretical argument gives rise to our "asymmetric CVP" (ACVP) framework. Whereas standard CVP defines a single line linking earnings to concurrent sales, the ACVP relation is described by two distinct lines. The upper ACVP earnings line applies in the case of sales increases. The lower ACVP earnings line is relevant for sales decreases, when earnings are reduced due to the retention of slack resources by managers. Because unused resources are retained to avoid adjustment costs, the vertical gap between the two ACVP earnings lines (i.e., the size of the sticky earnings differential) is likely to vary with the (firm-level) determinants of adjustment costs.

Practical applications of (standard or asymmetric) CVP require accurate cost structure estimates. Company managers, who have access to detailed internal data (including sufficient information to identify the "sticky" costs of unused resources) can obtain valid estimates even when costs behave asymmetrically. However, external analysts, who infer cost structure from reported accounting data, face additional estimation challenges. If costs are sticky, the standard model of fixed and variable costs is misspecified, leading to systematic bias in cost structure estimates. Therefore, we develop an alternative estimation approach (the ACVP model), which directly controls for cost stickiness. Further, even after controlling for sticky costs, external analysts' estimates are likely to be distorted because of conditional conservatism – asymmetric

recognition of future gains versus losses (Basu 1997). Conservatism does not play an explicit role in CVP-type analysis; however, publicly reported cost data reflects both current operating activities and the effects of conservative financial reporting. Because conservative accruals are likely correlated with concurrent sales changes, they can lead to omitted variable bias in the estimated relation between sales and costs. Consequently, we extend our estimation model to control for conservatism (the ACVP+C model), which allows us to obtain valid cost structure estimates from publicly reported accounting data.

We estimate our models using Compustat/CRSP data from 1979-2007. We find that incorporating cost stickiness in CVP-type analysis changes inferences considerably, both conceptually and quantitatively. Our ACVP estimates show that for the same current sales level, earnings are substantially lower when sales decrease (rather than increase) to this level. The size of this sticky earnings differential (i.e., the vertical gap between the two ACVP earnings lines) is equivalent to 47 percent of median operating income and 96 percent of median net income. In other words, when sales decrease, the amount of retained slack is sufficiently large to dramatically reduce operating income and to wipe out net income. This contrasts sharply with the standard CVP model, in which the direction of sales change has no effect on earnings. Furthermore, the impact of sales on earnings via the contribution margin (the focus of standard CVP) is relatively small compared to the impact of sales change direction: for operating income, the standard deviation of the contribution margin is equivalent to just 39 percent of the sticky earnings differential, and for net income, it is equal to only 10 percent. In other words, the retention of slack resources in response to sales decreases is a far more important determinant of earnings than is the variation in the contribution margin. We also find that the ACVP sticky

earnings differential varies substantially with firm characteristics; we capture this variation using our stickiness score (*SScore*) methodology.

Recognizing the asymmetry between sales increases and decreases leads to major modification in standard applications of CVP. For example, ACVP implies that each firm has two different breakeven benchmarks. Based on our estimates, the gap between the breakeven point for sales increases and the breakeven point for sales decreases is equivalent to 62 percent of lagged sales. In other words, for a given firm, the same current sales level can be *both* far above and far below breakeven depending on whether sales are increasing or decreasing relative to the prior period. Therefore, the standard CVP breakeven point (which is constrained to be the same for sales increases and decreases) does not provide an informative benchmark, neither for a firm with expanding sales nor for a firm with contracting sales. Likewise, ACVP implies that for a given level of budgeted sales, the firm has two distinct budgeted operating income targets depending on the planned direction of sales change. The gap between the two benchmarks is equivalent to 47 percent of median operating income. Therefore, operating budgets based on standard CVP (in which both benchmarks are assumed to be identical) are appropriate neither in the case of a budgeted sales increase nor in the case of a budgeted sales decrease. This also invalidates flexible budget performance targets and variances derived from standard CVP.

The findings indicate that even with accurate estimates of fixed, variable and sticky costs (which company managers can obtain by using detailed internal data), the very structure of CVP-type analysis has to be modified to account for the asymmetric effects of sticky costs. From the perspective of external analysts (who do not have access to detailed internal data, and use the standard cost structure model in estimation), the prevalence of cost stickiness leads to additional important biases. For example, the contribution margin ratio estimates from the standard model

are biased upwards, by 77 percent for operating income and by 312 percent for net income, compared to the ACVP estimates. Thus, to avoid large biases in the estimates, external analysts have to use an alternative estimation approach that accounts for cost stickiness (such as our ACVP model).

Additionally, we find that conditional conservatism has a significant confounding effect on CVP-type estimates. For example, without controls for conservatism, the estimates of the sticky earnings differential in the ACVP model would be biased upwards, by 11 percent for operating income and by 14 percent for net income, and the estimates of the impact of firm characteristics on stickiness would be biased by up to 108 percent. Thus, while cost accounting textbooks, practice and research typically ignore conservatism, it has to be controlled for to obtain accurate inferences in CVP-type analysis by outside parties and possibly by managers of other segments or divisions in a decentralized firm.

This paper is structured as follows. In section 2, we develop the empirical hypotheses of asymmetric CVP. In section 3, we discuss the data and the empirical model. Section 4 presents the empirical results, and section 5 concludes.

2. Hypothesis Development

We build on prior studies of sticky costs in cost accounting (e.g., ABJ; Weiss 2010) and conditional conservatism in financial accounting (e.g., Basu 1997; Watts 2003). We leverage the theory of sticky costs to generate new predictions for the relation between sales and costs, and show that asymmetric CVP (ACVP) analysis requires important conceptual changes in many of the standard CVP applications. We also demonstrate that both cost stickiness and conditional

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conservatism are likely to distort external analysts' cost structure estimates. Consequently, we modify the standard estimation models to incorporate both stickiness and conservatism.

2.1. The theory of sticky costs and its implications for the levels of costs and earnings

The CVP relation is based on a simple model of fixed and variable costs, which describes a linear relation between sales and costs. Because earnings = sales − costs, this model implies that earnings is a linear function of sales (panel A of Figure 1), and sales changes affect earnings only via changes in the contribution margin (sales − variable costs).

However, sticky costs research (e.g., ABJ; Weiss 2010; Banker et al. 2012, 2013; Kama and Weiss 2013) documents important asymmetries in cost behavior, which contradict the standard model but are consistent with an alternative model based on managerial discretion and resource adjustment costs. ABJ argue that when sales decrease, managers opt to retain some of the unused resources to avoid incurring adjustment costs associated with cutting resources, such as disposal costs for equipment or severance payments to dismissed workers.[1,2] By contrast, when sales increase sufficiently, managers have less discretion – they must add resources to accommodate the increased sales. This asymmetry in managerial discretion leads to cost stickiness: on average, costs fall less when sales decrease than they rise in response to equivalent sales increases. ABJ and numerous subsequent studies document the empirical prevalence of sticky costs and

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[1] Earlier studies by Noreen and Soderstrom (1997) and Cooper and Kaplan (1998) also highlighted the role of managers' resource commitment decisions in cost behavior and hinted at potential asymmetries. However, ABJ was the first study to document significant asymmetries in cost behavior and to provide a rigorous explanation for this phenomenon.
[2] In addition to economic adjustment costs borne by the firm (such as severance pay or productivity disruptions associated with layoffs), managers may also face psychological adjustment costs. For example, if managers have a preference for empire building, they will be reluctant to cut resources under their control when sales decrease, which will lead them to retain unused resources even in the absence of economic adjustment costs (ABJ, Chen et al. 2012).

demonstrate that the degree of cost stickiness varies across firms and over time in ways consistent with the theory.

Sticky behavior of costs implies an asymmetric relation between sales and earnings, which deviates in important ways from standard CVP. To incorporate cost stickiness in CVP-type analysis, we translate the main theoretical predictions of sticky costs, which are formulated in the extant literature in terms of *changes* in sales and costs, into new predictions for the *levels* of these variables. The key manifestation of cost stickiness in levels is that, for the same realized sales level in the current period, the level of costs depends on the direction of sales change relative to the prior period. The cost differential between sales decreases and increases reflects the asymmetric retention of slack resources by managers. When the realized sales level was reached from above (i.e., resource levels carried over from the prior period exceed current resource requirements), managers retain slack resources to save on the downward adjustment costs. Therefore, costs reflect the resource requirements (which are determined by the concurrent sales level) *plus* the retained slack resources. By contrast, when the same sales level was reached from below (i.e., original resource levels are insufficient), managers acquire additional resources to meet the increased demand. Because managers do not acquire unneeded resources, costs in this case reflect only the resource requirements. Consequently, costs are higher when sales decrease (rather than increase) to the same realized level in the current period.[3] This prediction leads to the main empirical property of the asymmetric CVP model: conditional on current sales level, earnings are lower if the realized sales level was reached from above than if it was reached

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[3] Notably, the standard ABJ formulation of stickiness provides no clear guidance on whether costs (conditional on sales) are higher for sales increases or decreases. ABJ stickiness means that costs decrease disproportionately less for sales decreases (which would appear to suggest that costs are higher in the case of sales decreases); however, it also means that costs increase disproportionately more for sales increases (which would suggest the opposite prediction that costs are higher for sales increases). Thus, a naive translation of ABJ stickiness from changes into levels would not yield informative predictions. We reconcile our predictions with ABJ and highlight the advantages of our approach in the next subsection.

from below. The "sticky earnings differential" between the two scenarios represents the cost of unused resources, which are present only in the former case.

We illustrate the difference between the standard CVP model (SCVP) and the asymmetric CVP model (ACVP) in Figure 1. In the SCVP model (panel A of Figure 1), total costs reflect only the required resource levels, which depend on the level (but not on the direction) of concurrent sales. Therefore, the standard CVP relation is represented by a single line linking earnings to sales. By contrast, the ACVP model (panel B of Figure 1) is derived from two distinct total costs lines. The lower line presents the total cost function in the case of sales increases, where costs reflect the required resource levels conditional on sales.[4] The upper line depicts the total cost function for sales decreases, which captures resource requirements conditional on sales plus retained slack resources.[5] Based on these total costs lines, the ACVP relation is represented by two distinct earnings lines, which relate earnings to concurrent sales in the case of sales increases (the upper line) and sales decreases (the lower line). The vertical distance between the two lines reflects the sticky earnings differential, which is associated with the retention of slack resources by managers.

The theoretical argument summarized in panel B of Figure 1 leads to the following prediction:

Hypothesis 1: *Conditional on the realized sales level, earnings are lower if this sales level was reached from above (i.e., sales decreased relative to the prior period) than if it was reached from below (i.e., sales increased).*

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[4] Expanding committed resources entails incurring upward adjustment costs, such as installation costs for equipment or recruiting and training costs for labor resources. Therefore, if managers can temporarily increase the capacity utilization rate beyond the sustainable long-term level, their choice of resource levels may be lower than that in the traditional SCVP model (which does not allow for adjustment costs). Thus, the total costs line for sales increases in ACVP may be below the total costs line in SCVP.

[5] The optimal amount of retained slack may vary with the scale of the firm, in which case the two total costs lines may have not only different intercepts but also different slopes.

The magnitude of the sticky earnings differential (i.e., the vertical gap between the two ACVP earnings lines) is likely to vary systematically across firms. When the adjustment costs are higher, managers will tolerate a greater level of slack resources in the event of a sales decrease, because it is now costlier to eliminate unused resources. Therefore, the sticky earnings differential should be larger for firms facing higher adjustment costs.

We use three firm-level proxies for adjustment costs: asset intensity (ratio of assets to sales), employee intensity (ratio of the number of employees to sales) and firm size. Higher asset and employee intensity indicates that the firm relies more on its own resources, which are costly to adjust, and less on purchases from outside suppliers, which can be ramped up or down with minimal adjustment costs (e.g., ABJ). Therefore, higher asset and employee intensity is associated with higher adjustment costs, which increase the sticky earnings differential. Conversely, larger firms are likely to have lower adjustment costs (per unit of resource adjustment). Many resources are lumpy (i.e., can be adjusted only in discrete increments); however, resource lumpiness is less important for large firms, for which the size of a typical resource adjustment is large relative to the scale of resource lumpiness. Therefore, larger firms are likely to have a smaller sticky earnings differential.

Hypothesis 2: *The sticky earnings differential (i.e., the vertical gap between the ACVP earnings lines for sales increases and decreases) is increasing with asset and employee intensity and decreasing with firm size.*

2.2. The connection between stickiness in levels and the ABJ definition of stickiness

We formalize cost stickiness in terms of two distinct total costs lines, which imply different *levels* of costs (for the same sales level) depending on the direction of sales change. By contrast,

prior studies (e.g., ABJ; Weiss 2010; Banker et al. 2012) have specified stickiness as asymmetric

slopes in the relation between *changes* in sales and costs. In Figure 2, we demonstrate that our

theoretical model reproduces the asymmetric slopes documented in prior studies. We also show

that this asymmetry actually reflects context-specific transitions *between* the two total costs lines,

rather than a well-defined cost function with asymmetric slopes. To generate the predictions for

changes, we fix the levels of sales and costs in the prior period *t-1* (*Sales$_{t-1}$* and *Costs$_{t-1}$*) and

examine the response of costs to sales changes in the current period *t* (the changes are indicated

by the arrows in Figure 2). Costs are determined by the lower (upper) total costs line when sales

increase (decrease). In other words, knowing the level and the direction of current period sales is

sufficient to determine the level of costs.[6] However, when viewed through the lens of

asymmetric slopes (the ABJ definition of stickiness), *the same* predictions for the level of costs

can manifest themselves in dramatically different ways, because the slopes are directly affected

by an additional variable – the level of costs in the prior period.

We illustrate these differences in panels A and B of Figure 2. The realized sales level and the

sales change relative to the prior period are the same in both panels; therefore, the predictions for

the level of costs are identical. However, these identical predictions for levels manifest

themselves very differently in terms of the asymmetry in slopes: while they lead to ABJ

stickiness in panel A, they generate the *opposite* pattern of anti-stickiness in panel B.[7] In panel A,

the lagged costs are on the lower total costs line (which would be the case if sales increased in

prior period *t-1* relative to *t-2*). Therefore, current sales increases lead to further cost expansion

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[6] In this example, we focus on sales changes that are sufficiently large to trigger resource adjustment to the relevant total costs line (for small sales changes, costs may remain unchanged in the inaction zone between the two lines, where the mismatch between committed resources and demand is too small to justify incurring adjustment costs to better align resource levels with current sales).

[7] Weiss (2010) defines costs to be "anti-sticky" if they increase less for sales increases than they decrease for sales decreases.

along the same total costs line, whereas current sales decreases lead to a transition *between* the

two total costs lines. This results in an asymmetrically weaker cost response for sales decreases

(i.e., ABJ stickiness). By contrast, in panel B, the lagged costs are on the upper total costs line

(which would be the case following a prior sales decrease). Therefore, current sales decreases

cause further cost reduction along the same total costs line, whereas current sales increases result

in a transition between the two total costs lines. This leads to an asymmetrically weaker cost

response for sales increases (i.e., anti-stickiness).[8] As Banker et al. (2012) point out, sales

increases are more common in Compustat data than are decreases;[9] therefore, the "sticky"

scenario from panel A (which follows a prior increase) dominates on average, generating ABJ's

findings of average stickiness. However, as Figure 2 demonstrates, both the "sticky" scenario

from panel A and the "anti-sticky" scenario from panel B represent context-specific transitions

between two stable total costs lines; the predictions for the *level* of costs are identical in both

cases. Thus, our formulation of cost stickiness in terms of two distinct total costs lines provides a

more fundamental and better interpretable description of asymmetric cost behavior than do the

context-specific asymmetries in slopes that were the focus of prior studies.

2.3. Practical implications of cost stickiness for CVP-type analysis

    Incorporating cost stickiness in CVP-type analysis requires conceptual revisions in many

standard CVP applications. For example, in the context of operating budgets derived from ACVP,

budgeted costs and earnings should be corrected for whether the planned sales level represents an

increase or a decrease relative to the prior period (Hypothesis 1). The magnitude of this

correction varies with the observable firm characteristics (Hypothesis 2). Accordingly, in section

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[8] This prediction is supported by Banker et al.'s (2012) findings of anti-stickiness following a prior sales decrease.
[9] For example, in our data sales increases (decreases) account for 65% (35%) of the sample.

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3 we introduce a firm-year "stickiness score" ($SScore_{i,t}$), which provides a practical way to estimate the required correction (i.e., the size of the sticky earnings differential) for each firm-year. Breakeven analysis requires a similar correction for the direction of sales change. ACVP implies that each firm has two different breakeven benchmarks: a lower breakeven point that is relevant when sales are expanding, and a higher breakeven point in the case of contracting sales (Figure 3). Likewise, in evaluating production managers' performance using flexible budget variances, the asymmetric flexible budget performance benchmarks should be adjusted for the direction of sales change. When a production manager (who is not accountable for the realized sales) is facing a sales decrease, her efficiency and cost benchmarks should become more lenient as she cannot fully eliminate unused resources without incurring inefficiently large adjustment costs (and it would not be optimal to do so). Conversely, sales managers who are responsible for decreased sales should be held accountable not only for the reduced contribution margin but also for the cost of unused resources that had to be retained.

Notably, company managers who make resource commitment decisions (including the decision to retain unused resources) are aware of asymmetries in the relation between sales and resource levels. However, CVP analysis is designed to provide a direct link from sales to earnings. In other words, its function is to offer a simple approximation that allows managers to evaluate alternative scenarios for sales without having to directly model the underlying resource choices. To the extent that managers mechanically rely on CVP and related planning and control tools (or are forced to do so by the established procedures[10]), the insights they might have in the context of resource commitment decisions are likely to be overlooked in decisions typically

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[10] For example, in the standard account classification method, which only allows for "fixed" and "variable" categories, cost accounts that represent retained slack resources (i.e., sticky costs) are (mis)classified as fixed or variable costs. Thus, the very structure of this method ensures the loss of managers' insights about sticky costs.

made using CVP.[11] Our ACVP model provides an alternative approximation, which allows managers to capture the asymmetries in the relation between sales and earnings without having to directly consider the details of the underlying resource commitments.

When costs are sticky, the use of standard CVP leads to important value-destroying distortions in many operating decisions. For example, because standard CVP overestimates earnings in the case of sales decreases, it may substantially understate the risks associated with deteriorating sales (which is also the situation when accurate risk assessment is most crucial). Standard CVP analysis may also underestimate earnings in the case of sales increases, potentially deterring managers from profitable sales expansion. In budgeting, when a company is planning for an anticipated sales increase using the standard model, budgeted costs for the upcoming period are likely to exceed actual resource requirements, encouraging inefficiency. Conversely, in the case of an anticipated sales contraction, budgeted costs are likely to be below the optimal level, encouraging excessive, mechanical cost-cutting.[12] Likewise, in evaluating production managers using flexible budget variances, the standard flexible budget benchmarks are likely to lead to unwarranted favorable (unfavorable) evaluation bias when sales increase (decrease), adding noise to and reducing the power of managers' incentives.

These conceptual issues apply even when managers have accurate cost structure estimates obtained from detailed internal data (which allows them to directly separate the sticky costs of unused resources from conventional fixed and variable costs). Additionally, cost stickiness is likely to distort external analysts' cost structure estimates, which are based on publicly available

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[11] Notably, some cost accounting textbooks recognize (in other contexts, such as strategic profitability analysis in Horngren et al. 2009, 474) that capacity costs behave asymmetrically with respect to sales changes below and above available capacity levels. However, these insights are not reflected in their treatment of CVP.

[12] Under cost stickiness, managers retain slack resources because it is cheaper for the firm to tolerate some slack than to incur adjustment costs associated with removing resources. Therefore, mechanically eliminating all unused resources is likely to be value-destroying.

accounting data. Under sticky costs, sales decreases are associated with disproportionately high costs (conditional on sales). Sales decreases are also negatively correlated with the concurrent sales level. Thus, when sales are low, costs are likely to be unusually high due to cost stickiness. Therefore, the standard CVP model (which does not control for the direction of sales change) is likely to suffer from downward bias in the estimates of variable costs and upward bias in the estimates of fixed costs. In other words, in addition to systematically overestimating (underestimating) costs in the case of sales increases (decreases), external analysts are likely to mischaracterize even the average mix of fixed and variable costs. Therefore, in section 3 we introduce an alternative empirical model (the ACVP model), which directly incorporates stickiness in estimation.

2.4. The confounding role of conservatism in external analysts' CVP estimates

Studies in financial accounting (e.g., Basu 1997; Watts 2003; Khan and Watts 2009) document a piecewise-linear relation between earnings and stock returns and interpret it as evidence of conditional conservatism – asymmetric recognition of good versus bad news about future cash flows. Because conservatism represents asymmetry only in financial reporting (as opposed to an asymmetry in operating activities), it has largely been ignored in management accounting research and practice. However, when cost structure estimates are derived from publicly reported accounting data, it is important to control for the confounding role of conservative accruals in reported costs and earnings.

Although conservatism mostly flows through non-operating income (discontinued operations, special and extraordinary items), some conservative accruals are written off directly to operating costs. Thus, reported operating costs reflect both the outcomes of current operating activities and

the early recognition of anticipated future losses. Because stock returns (the standard proxy for news about future cash flows) are positively correlated with concurrent sales changes,[13] cost structure estimates derived from publicly reported accounting data are likely to be distorted due to a correlated omitted variable problem. This bias primarily affects external users, who do not have access to detailed internal data and, therefore, cannot directly strip out conservative accruals from reported operating costs.[14]

This correlated omitted variable problem is likely to distort estimates even in the modified model that directly controls for cost stickiness. Because conservative write-downs are asymmetrically larger for bad news than for good news, and bad news (negative stock returns) is positively correlated with sales decreases, conditional conservatism is likely to be mistaken for cost stickiness. This leads to upward bias in the estimates of cost stickiness.

Hypothesis 3: *If conservatism is ignored in estimation, the estimates of the sticky earnings differential are biased upwards.*

The impact of conditional conservatism on reported costs and earnings varies across firms. Because conservatism is likely to be mistaken for cost stickiness, *variation* in conservatism can bias the estimates of variation in stickiness. This may distort the estimates of the relation between firm characteristics and cost stickiness developed in Hypothesis 2. In particular, when bad news reduces the fair value of assets on the balance sheet, more asset-intensive firms are likely to record larger asset write-downs, resulting in greater measured conservatism. Likewise,

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[13] The correlation between stock returns and concurrent log-changes in sales in our sample is 0.203, and the correlation between the negative stock returns dummy and the sales decrease dummy is 0.155, both significant at the 1 percent level.

[14] Internal users, who have access to detailed write-downs data, can directly separate conservative accruals from "true" operating costs. However, this may require changes in the established estimation procedures.

when bad news indicates greater likelihood of large future layoffs, more employee-intensive firms are likely to record a larger allowance for future severance pay and other costs associated with laying off workers, leading to increased conservatism. Conversely, larger firms are likely to exhibit less conservatism, because they have a richer information environment (e.g., more analyst following), which reduces information asymmetries and hence reduces the demand for conservatism (e.g., Khan and Watts 2009). In a model that does not control for the effect of these variables on conservatism (and, hence, misinterprets variation in conservatism as variation in stickiness), the estimates of their impact on stickiness are likely to be distorted: the coefficient on asset and employee intensity will be biased upwards and the coefficient on firm size will be biased downwards.

> Hypothesis 4: *If conservatism and its interactions with the firm characteristics are ignored in estimation, the estimates of the impact of asset and employee intensity on stickiness are biased upwards, and the estimates of the impact of size on stickiness are biased downwards.*

In robustness checks, we exploit two additional testable implications of conservatism. First, because many conservative accruals flow through the non-operating component of net income, conservatism should be stronger for net income than for operating income (Basu 1997). Second, because conservatism is solely a financial reporting phenomenon (i.e., it manifests itself in accruals but not in real resource commitments), it should be detected in reported costs and earnings but not in physical resource measures, such as the number of employees. By contrast, stickiness should be observed both in reported financial variables and in physical resource levels. These predictions offer essential validity tests of whether our estimation approach successfully separates stickiness from conservatism.

In addition to distorting external analysts' cost structure estimates, conservatism plays a conceptually important role in some applications of CVP. Conservative accruals represent early recognition of future losses, which are unrelated to current operating activities. Therefore, they should be excluded from earnings in most (but not all) applications of CVP, in which the emphasis is on the profit consequences of concurrent operating activities. However, if the goal of CVP-type analysis is to project reported net income (which is of interest to outside investors, analysts or senior managers interested in forecasting or managing net income), conservative accruals should be included in projected earnings. Therefore, in such applications, CVP earnings estimates should be supplemented with estimates of conservative accruals.

3. Data and Estimation Models

3.1. Sample selection and descriptive statistics

We use the combined Compustat/CRSP sample from 1979-2007.[15] All financial variables are deflated using the Consumer Price Index (CPI) from http://www.bls.gov/cpi/ to control for inflation. We use two earnings measures: operating income (Compustat item OIADP), which is more relevant for internal operating decisions made by production or sales managers, and net income (item NI), which is of greater interest to investors and external analysts. The variable definitions are summarized in Table 1.

We discard firm-year observations if (1) sales, total assets or market value is missing or negative, (2) operating income or net income is missing, or it exceeds concurrent sales revenue (because that would mean that costs are negative), (3) end-of-period stock price is below $1, or

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[15] We end the sample in 2007 to avoid the effects of the 2008 financial crisis, which triggered unusually large asset write-downs in 2008-2009 (and, thus, may overstate the typical importance of conditional conservatism). The results are similar when we extend the sample to 2011.

(4) the control variables (asset intensity, employee intensity and firm size) are missing or invalid.[16] We also discard 1 percent of extreme values on each tail for all continuous regression variables. The final estimation sample consists of 84,846 firm-years for 11,346 firms.

We present the descriptive statistics and the correlation matrix in panels A and B of Table 2. Earnings is scaled by lagged sales, because sales level is the primary determinant of the scale of costs and earnings. On average, operating income is equal to 6.1 percent of lagged sales, and the median is 8.5 percent. For net income, the average is equal to -0.3 percent of lagged sales, and the median is 4.4 percent. Both earnings measures are negatively skewed (mean < median), which is consistent with the presence of conditional conservatism (Basu 1995). Sales decreases ($SD_{i,t}=1$) account for 34.7 percent of the sample. The Pearson correlation between the sales decrease dummy ($SD_{i,t}$) and scaled sales ($SALES_{i,t}/SALES_{i,t-1}$) is -0.609, significant at the 1 percent level, indicating that the asymmetric effects of cost stickiness are likely to have an important confounding effect on the standard cost structure estimates. The correlation between the sales decrease dummy $SD_{i,t}$ and the negative returns dummy $DR_{i,t}$ (the standard proxy for bad news in conservatism research, e.g., Basu 1997, Ryan 2006) is 0.155, significant at the 1 percent level, suggesting that conservative accruals may be an important correlated omitted variable in estimation of the asymmetric CVP relation.

3.2. Estimation models

We start with the standard CVP model and then extend it to incorporate cost stickiness and conditional conservatism. Because earnings = sales – costs, we directly estimate the relation between sales and earnings (rather than costs); this approach is equivalent to first estimating the

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[16] Because some of the variables enter our models as lagged values or as year-on-year changes, we apply these screening criteria to both current and prior year observations.

cost structure parameters and then plugging in the estimates into the CVP equation.[17] In all regressions for earnings, we scale earnings on the left hand side and sales on the right hand side by prior period sales.[18] To ensure that the cost structure estimates are identified from time-series variation in sales for the same firm (as opposed to cross-sectional differences between firms), in all models we include firm fixed effects.

Our first model is the standard CVP relation linking earnings to sales:

SCVP model (standard CVP)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \varepsilon_{i,t} \tag{1}$$

where $EARN_{i,t}$ is earnings (operating or net income) for firm i in year t, $SALES_{i,t}$ is sales revenue for firm i in year t, and $\varepsilon_{i,t}$ is an error term. The coefficient $\alpha_{0,i}$ is the estimated fixed cost for firm i. The slope α_1 represents the average contribution margin ratio.

We next incorporate cost stickiness by allowing the level of earnings (conditional on concurrent sales level) to depend on the direction of sales change:

ACVP model (asymmetric CVP)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} + \eta_{i,t} \tag{2}$$

where $SD_{i,t}$ is a sales decrease dummy, equal to 1 if $SALES_{i,t} < SALES_{i,t-1}$ and zero otherwise, and the remaining variables were defined previously. The coefficient α_2 captures the sticky earnings differential (i.e., the vertical gap between the ACVP earnings lines for sales increases and

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[17] For example, in the standard model of fixed and variable costs, if $COSTS=F+v{\times}SALES$, then earnings is given by $EARN = SALES - COSTS = -F+(1{-}v){\times}SALES$. Therefore, the intercept and slope estimates in a regression of earnings on sales will be identical to $-\hat{F}$ and $(1-\hat{v})$ from a regression of costs on sales.

[18] The results are similar when we scale by lagged book value of assets, lagged book value of equity, lagged market value of equity or average sales for firm i over the sample period.

decreases).[19] Hypothesis 1 implies $\alpha_2 < 0$, i.e., for the same concurrent sales level $SALES_{i,t}$,

earnings is lower if $SALES_{i,t}$ was reached from above ($SALES_{i,t-1} > SALES_{i,t}$, i.e., $SD_{i,t} = 1$) than if it

was reached from below ($SALES_{i,t-1} < SALES_{i,t}$, i.e., $SD_{i,t} = 0$). As discussed in section 2, the

estimates of fixed and variable costs in the standard SCVP model are likely to be biased relative

to those in the ACVP model (downward bias in the intercept $\alpha_{0,i}$ and upward bias in the slope α_1).

For consistency with ABJ's analysis, in robustness checks we also examine the behavior of

log-changes in costs. We use the log-change counterparts of the SCVP and ACVP models:[20]

$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \mu_{i,t} \tag{3}$$

$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \alpha_2 SD_{i,t} \Delta \ln SALES_{i,t} + v_{i,t} \tag{4}$$

where $\Delta \ln COST_{i,t}$ is the log-change in costs from year $t-1$ to year t for firm i, $\Delta \ln SALES_{i,t}$ is the

log-change in sales, $SD_{i,t}$ is the sales decrease dummy as defined earlier, and $\mu_{i,t}$ and $v_{i,t}$ are the

error terms. We estimate these models both for operating costs (sales less operating income) and

for total costs (sales less net income). ABJ stickiness for log-changes implies $\alpha_2 < 0$, i.e., costs fall

less for sales decreases than they rise in response to equivalent sales increases.

To examine the impact of firm characteristics on cost stickiness, we estimate an extended

version of the ACVP model:

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[19] As discussed in section 2, we do not have *a priori* expectations for whether the slope coefficient α_1 should be higher or lower for sales decreases. In robustness checks, we extend the ACVP model to allow the slope α_1 to vary with the direction of sales change.
[20] Because earnings can be negative, log-changes are not always defined for earnings. Therefore, we switch from earnings to costs.

Extended ACVP model (asymmetric CVP model with firm characteristics)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + $$
$$+ (\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1})SD_{i,t} + \varsigma_{i,t} \qquad (5)$$

where $AINT_{i,t-1}$ is beginning-of-year asset intensity for firm i (log-ratio of assets to sales),

$EINT_{i,t-1}$ is beginning-of-year employee intensity (log-ratio of the number of employees to sales),

$SIZE_{i,t-1}$ is beginning-of-year firm size (measured as log market value of the firm following

Kama and Weiss 2013), and the remaining variables were defined previously.[21] Hypothesis 2

predicts that stickiness is increasing with asset and employee intensity ($\alpha_3 < 0$, $\alpha_4 < 0$) and

decreasing with firm size ($\alpha_5 > 0$).[22]

We also use the extended ACVP estimates to generate firm-year stickiness scores, defined as

the predicted sticky earnings differential (i.e., the total coefficient on $SD_{i,t}$ in equation (5),

including all interaction terms) conditional on firm characteristics:

$$SScore_{i,t} = -(\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1}) \qquad (6)$$

where all variables are defined previously. The minus sign in the formula converts *SScore* into a

positive number, which facilitates comparisons (i.e., higher positive *SScore* indicates greater

stickiness). $SScore_{i,t}$ captures the vertical distance between the ACVP earnings line for sales

increases and the ACVP earnings line for sales decreases conditional on beginning-of-year

values of *AINT*, *EINT* and *SIZE*. It provides a firm-year correction for the direction of sales

change that can be used in practical applications of asymmetric CVP.

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[21] We use beginning-of-year values of *AINT*, *EINT* and *SIZE* for two reasons. First, this timing is more appropriate on statistical grounds, as end-of-year assets and market value are partly determined by concurrent earnings (the dependent variable). Therefore, the use of end-of-year asset intensity and size as independent variables would artificially inflate their explanatory power and distort the estimates. Second, to be useful in practical applications of ACVP (i.e., evaluation of alternative scenarios for year t sales), these variables need to be known at the beginning of year t.

[22] Because the sticky earnings differential in the ACVP model is a negative number, negative coefficients on firm characteristics indicate increasing stickiness (i.e., a more negative sticky earnings differential).

To examine the role of conditional conservatism in reported earnings and its impact on CVP-type estimates, we extend the ACVP model to incorporate conditional conservatism (Basu 1997):

ACVP+C model (asymmetric CVP model with controls for conservatism)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} +$$
$$+ \beta_1 DR_{i,t} + \beta_2 RET_{i,t} + \beta_3 DR_{i,t} RET_{i,t} + \upsilon_{i,t} \tag{7}$$

where $RET_{i,t}$ represents stock returns of firm i in year t (computed over the 12-month period of the fiscal year), $DR_{i,t}$ is a dummy variable equal to 1 if $RET_{i,t}$ is negative and zero otherwise, and the remaining variables are defined previously. Conservatism implies $\beta_3 > 0$ (Basu 1997), i.e., bad news (using negative returns as a proxy) is recognized in earnings more quickly and more fully than good news (positive returns). Hypothesis 3 predicts that the estimated sticky earnings differential α_2 in the ACVP+C model is lower (in absolute value) relative to that in the ACVP model, as the latter suffers from omitted variable bias associated with conservatism.

In robustness checks, we also examine the log-change version of the ACVP+C model, estimated for log-changes in costs following ABJ:

$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \alpha_2 SD_{i,t} \Delta \ln SALES_{i,t} +$$
$$+ \beta_1 RET_{i,t} + \beta_2 DR_{i,t} RET_{i,t} + \xi_{i,t} \tag{8}$$

where all variables were defined previously.[23] Because this model describes costs rather than earnings, the predicted sign of the conservatism coefficient is reversed ($\beta_3 < 0$). ABJ stickiness implies $\alpha_2 < 0$. The estimate of cost stickiness α_2 in the log-change ACVP model should be biased upwards (in absolute value) relative to that in the parallel ACVP+C model (Hypothesis 3).

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[23] Because the ABJ model does not include the sales decrease dummy $SD_{i,t}$ as a stand-alone independent variable, for consistency we also do not include the negative returns dummy $DR_{i,t}$ as a stand-alone term (the results are similar when we include both dummies).

The degree of conditional conservatism is likely to vary with firm characteristics, which can distort the estimates of variation in stickiness. Therefore, we also estimate an extended ACVP+C model, in which firm characteristics may affect both stickiness and conservatism:

Extended ACVP+C model (asymmetric CVP model with controls for conservatism and firm characteristics)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} +$$
$$+ (\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1}) SD_{i,t} + \qquad (9)$$
$$+ \beta_1 DR_{i,t} + \beta_2 RET_{i,t} +$$
$$+ (\beta_3 + \beta_4 AINT_{i,t-1} + \beta_5 EINT_{i,t-1} + \beta_6 SIZE_{i,t-1}) DR_{i,t} RET_{i,t} + \psi_{i,t}$$

where all variables are defined previously. Similar to the extended ACVP model, we expect $\alpha_3<0$, $\alpha_4<0$ and $\alpha_5>0$ (i.e., cost stickiness increases with asset and employee intensity and decreases with firm size – Hypothesis 2). We also expect $\beta_4>0$, $\beta_5>0$ and $\beta_6<0$ (i.e., conservatism is higher for asset-intensive and labor-intensive firms and lower for large firms). Based on Hypothesis 4, the estimated impact of asset intensity and employee intensity on stickiness (α_3 and α_4) in the extended ACVP model should be biased upwards relative to that in the extended ACVP+C model, and the estimated impact of firm size (α_5) should be biased downwards.

We use the extended ACVP+C model to generate adjusted stickiness scores (*Adj.SScore*) for each firm-year:

$$Adj.SScore_{i,t} = -(\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1}) \qquad (10)$$

where all variables are defined previously. Notably, even though *AINT*, *EINT* and *SIZE* enter both stickiness and conservatism, the Adjusted *SScore* only reflects their effect on stickiness. In other words, we control for the impact of these variables on conservatism to avoid omitted

variable bias in the stickiness estimates, but we do not – and should not – include these controls in the stickiness score.

4. Empirical Results

We first compare the estimates of asymmetric CVP (ACVP) against standard CVP (SCVP) and illustrate the new practical implications of our ACVP model. After that, we examine the consequences of adding controls for conservatism in CVP estimation (the ACVP+C model). Because our analysis is based on publicly available accounting data, it directly reflects external analysts' perspective; however, most of our findings are equally relevant for company managers, who face the same conceptual issues related to incorporating cost stickiness in CVP analysis, and many of the same estimation issues.[24]

4.1. Standard versus asymmetric CVP

The estimates of standard and asymmetric CVP (the SCVP and ACVP models, respectively) are presented in Table 3. The main parameter of interest is the sticky earnings differential α_2 in the ACVP model, which measures the vertical gap between the earnings line for sales increases ($SD_{i,t}=0$) and the earnings line for sales decreases ($SD_{i,t}=1$). Hypothesis 1 predicts $\alpha_2<0$. As expected, both for operating income and for net income, the estimate of α_2 is negative and highly significant (α_2=-0.040, t=-21.16 and α_2=-0.042, t=-20.93, respectively). Thus, cost stickiness plays a statistically significant role in the relation between sales and earnings. The standard CVP relation (the SCVP model) is nested within the ACVP model under the restriction α_2=0. This

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[24] Company managers have access to disaggregated costs data, which allows them to use additional estimation methods such as account classification. Because these methods require detailed proprietary data, we do not examine their empirical performance.

restriction is rejected at the 0.1 percent level, indicating that the asymmetric CVP model is more appropriate than standard CVP on statistical grounds. The sticky earnings differential α_2 is also highly economically significant: the vertical distance between the ACVP earnings lines for sales increases and decreases (for the same sales level on both lines) is equivalent to 47 percent of median operating income and 96 percent of median net income.[25,26] In other words, for the same realized sales $SALES_{i,t}$ (*after* the sales increase or decrease), earnings are dramatically lower if $SALES_{i,t}$ represents a decrease from the prior period ($SD_{i,t}$=1) than if it represents an increase ($SD_{i,t}$=0). In untabulated robustness checks, the estimates of the sticky earnings differential are similar when we use alternative scaling by lagged book value of assets, lagged book value of equity, lagged market value of equity or average sales of firm i over the sample period. The results are also similar when we allow for different slopes α_1 for sales increases and decreases.

In Figure 4, we plot the standard and asymmetric CVP relations defined by the SCVP and ACVP estimates, respectively. Standard CVP substantially overestimates earnings for sales decreases and underestimates earnings for sales increases. Furthermore, the size of the sticky earnings differential (i.e., the vertical distance between the ACVP lines for sales increases and decreases in Figure 4) is large relative to the impact of sales changes via the contribution margin. For example, based on the ACVP estimates for operating income, the standard deviation of the contribution margin (scaled by lagged sales) is equal to $\alpha_1 \times SD(SALES_{i,t}/SALES_{i,t-1})$=0.016, which is equivalent to only 39 percent of the sticky earnings differential α_2; for net income, it is equal to just 10 percent. In other words, the asymmetric retention of slack resources in response to sales

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[25] Because the mean of net income is negative (panel A of Table 2), the median provides a more meaningful yardstick of economic significance than does the mean. The mean of operating income is positive (which allows for a meaningful comparison), and the sticky earnings differential is equivalent to 66 percent of the mean.

[26] These percentages are computed as follows. The median of operating income (scaled by lagged sales) is 0.085 (panel A of Table 2), and the sticky earnings differential α_2=-0.040 is equivalent to 0.040/0.085 = 47% of the median operating income. The median of (scaled) net income is 0.044, and α_2=-0.042 is equivalent to 0.042/0.044 = 96% of the median.

decreases plays a much larger role in earnings behavior than does the variation in the

contribution margin (the focus of standard CVP). Thus, even when the estimates of fixed and

variable costs in standard CVP are accurate (i.e., sticky costs are not misclassified as fixed or

variable), the use of standard CVP in place of asymmetric CVP would provide a highly distorted

view of earning behavior.

The standard CVP model also suffers from systematic bias in the estimates of fixed and

variable costs. The intercept in the SCVP model is biased downwards relative to the ACVP

estimates and the slope is biased upwards; both biases are statistically significant (Table 3). Thus,

as expected (subsection 2.3), when external analysts estimate the standard model using publicly

available data, they overestimate fixed costs and underestimate variable costs.[27] The bias in the

cost structure estimates is also economically significant. For example, the SCVP model

overestimates the contribution margin ratio by 77 percent for operating income (α_1=0.115 in

SCVP versus α_1=0.065 in ACVP), and by 312 percent for net income (α_1=0.070 in SCVP versus

α_1=0.017 in ACVP). By controlling for the effect of sales change direction on earnings, our

ACVP model undoes this bias.

In the extended ACVP model, we add controls for the firm-level determinants of stickiness:

asset intensity, employee intensity and firm size. The point estimates are presented in panel A of

Table 4. As expected (Hypothesis 2), both for operating income and for net income, the sticky

earnings differential is increasing with asset intensity (α_3=-0.029 and α_3=-0.031 for operating and

net income, respectively) and employee intensity (α_4=-0.027 and α_4=-0.032, respectively), and

decreasing with firm size (α_5=0.004 and α_5=0.004, respectively); all three effects are significant

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[27] Because earnings = sales – costs, the direction of bias in the estimates for costs is a mirror image of that for
earnings.

at the 0.1 percent level. Thus, the magnitude of the sticky earnings differential in asymmetric CVP varies systematically across firms in ways consistent with the theoretical predictions.

The estimates indicate that the correction for the direction of sales change in practical applications of asymmetric CVP should be firm-specific, and that it varies significantly with firm characteristics. We use the extended ACVP model to generate estimates of the stickiness score $SScore_{i,t}$, which measures the required correction for each firm-year (i.e., the size of the sticky earnings differential conditional on firm characteristics). We compute the stickiness scores as

$SScore_{i,t} = -(\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1})$, where higher positive values indicate greater stickiness. Because $SScore$ is based on variables that are known at the beginning of year t, it can be used (both by company managers and by external analysts) to evaluate alternative scenarios on sales in period t.

The descriptive statistics for the stickiness scores are presented in panel B of Table 4. The $SScores$ exhibit substantial heterogeneity. For example, for a firm at the bottom quartile of $SScore$, the required correction to operating income in evaluating a sales decrease scenario is equivalent to 2.4 percent of lagged sales ($SScore$=0.024[28]), which amounts to 28.2 percent (=0.024/0.085) of median operating income. For a firm at the top quartile of $SScore$, the required correction is more than twice as large – 6.0 percent of lagged sales ($SScore$=0.060), or 70.6 percent (=0.060/0.085) of median operating income. The relative magnitudes for net income are similar: 2.5 percent versus 6.5 percent of lagged sales, or 56.8 percent versus 147.7 percent of median net income. Thus, the sticky earnings differential varies considerably across firms; our $SScore$ methodology allows both internal and external users to account for this variation in applications of asymmetric CVP.

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[28] Because earnings is scaled by lagged sales, the estimated impact of $SScore$ on earnings is measured as a fraction of lagged sales.

Our findings indicate the need for major conceptual changes in the fundamental framework of CVP. As documented earlier, the impact of sales changes on earnings via the contribution margin (the focus of standard CVP) is relatively small (10-39 percent) compared to the impact of sales decreases on earnings via retained slack resources. Therefore, the fundamental focus in CVP-type analysis should shift considerably to align with these relative magnitudes. This implies placing less emphasis on managing the contribution margin and much more weight on measuring and managing the costs of retained unused resources.

Our estimates also lead to large changes in many applications of CVP. For example, each firm has two different ACVP breakeven benchmarks (a lower breakeven level when sales are expanding and a higher breakeven level when sales are contracting). Based on the ACVP estimates for operating income (Table 3), the difference between the two break-even points for the same firm is equivalent to 62 percent of lagged sales.[29] In the extended ACVP model, the difference between the two benchmarks ranges from 38 percent of lagged sales for a firm at the bottom quartile of *SScore* to 94 percent of lagged sales for a firm at the top quartile of *SScore*.[30] Thus, the current sales level for a given firm can be both far above the breakeven level (if sales are growing) and far below breakeven (if sales are shrinking). This requires a fundamental revision in the very structure of the analysis. Notably, because the two ACVP benchmarks are far apart, the standard CVP breakeven point (which approximates a weighted average of the two ACVP benchmarks) is largely uninformative, both for a firm with expanding sales and for a firm with contracting sales.

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[29] The break-even point in the ACVP model is equal to $-\alpha_{i,0}/\alpha_1$ in the case of increasing sales, and $-(\alpha_{i,0}+\alpha_2)/\alpha_1$ when sales are decreasing, where $\alpha_{i,0}$ is the (firm-specific) fixed cost, α_1 is the contribution margin ratio, α_2 is the sticky earnings differential, and all variables are scaled by lagged sales. Based on the estimates for operating income in Table 3, the difference between the two break-even points is $-\alpha_2/\alpha_1=0.040/0.065=0.62$ of lagged sales.
[30] Similar to the previous footnote, the difference between the two break-even points is computed as $SScore/\alpha_1$, where $\alpha_1=0.064$ (panel A of Table 4) and *SScore* equals 0.024 at the bottom quartile and 0.060 at the top quartile.

In the context of budgeting, ACVP implies that each firm has two distinct budgeted earnings benchmarks depending on the planned direction of sales change. As documented earlier, the difference between these two benchmarks (for the same budgeted sales level for the same firm) in the ACVP model is equivalent to 47 percent of median operating income. In the extended ACVP model, it ranges from 28 percent at the bottom quartile to 71 percent at the top quartile. Therefore, budgeted earnings based on standard CVP (which reflect a weighted average of the two ACVP earnings benchmarks) are likely to be unacceptably crude, both when managers are planning for a budgeted sales increase and when they are considering a budgeted sales decrease. The same issues applies to flexible budgets and other CVP applications: because the relevant ACVP benchmark conditional on a sales increase is substantially different from that conditional on a sales decrease, standard CVP (i.e., a weighted average of the two benchmarks) does not provide a meaningful answer regarding either one.

4.2. The impact of conditional conservatism on asymmetric CVP estimates

Even after controlling for cost stickiness, external analysts' CVP estimates are likely to be distorted because of conditional conservatism in reported accounting data (Hypotheses 3 and 4). We compare asymmetric CVP estimates without and with controls for conservatism (the ACVP and ACVP+C models, respectively) in Table 5. Consistent with prior studies (e.g., Basu 1997), we observe significant conservatism ($\beta_3 > 0$) for both operating and net income. Conservatism is significantly stronger for net income than for operating income ($\beta_3 = 0.138$, $t = 20.67$ versus $\beta_3 = 0.092$, $t = 14.75$, respectively; the difference is significant at the 0.1 percent level). As expected, while many conservative accruals flow through non-operating items (resulting in

greater conservatism for net income), a substantial amount is written off directly to operating costs (as indicated by significant conservatism for operating income).

Hypothesis 3 predicts that the stickiness estimates in the ACVP model are biased upwards (in absolute value) because of the correlated omitted variable problem associated with conditional conservatism. We address this bias in the ACVP+C model by adding controls for conservatism. Consistent with our predictions, the ACVP model significantly overestimates the sticky earnings differential, by 11.4 percent for operating income (α_2=-0.040 in ACVP versus α_2=-0.036 in ACVP+C), and by 14.2 percent for net income (α_2=-0.042 versus α_2=-0.037); both biases are significant at the 0.1 percent level (Table 5). Thus, as expected, controlling for conservatism is essential for obtaining accurate estimates from reported accounting data. Notably, these controls are important not only for net income (which is known to include all conservative write-downs) but also for operating income. Thus, even though cost accounting research and practice have largely ignored the impact of conservatism on reported operating costs and income, it has to be taken into account to obtain valid CVP estimates.

To further illustrate the bias that arises from ignoring conservatism in estimation, in Figure 5 we plot the estimated relation between sales and earnings for the asymmetric CVP models without and with controls for conservatism (the ACVP and ACVP+C models, respectively). Consistent with our theoretical argument, the ACVP model underestimates earnings for sales decreases (because it misinterprets early recognition of future losses as evidence of unusually high current operating costs). It also slightly overestimates earnings for sales increases.

The ACVP+C estimates indicate that, even after controlling for conservatism, earnings exhibit statistically significant stickiness (α_2=-0.036, t=-19.04 for operating income and α_2=-0.037, t=-18.42 for net income). The size of the sticky earnings differential is also highly

economically significant: the vertical distance between the earnings lines for sales increases and decreases is equivalent to 42 percent of median operating income, and 84 percent of median net income.

In the extended ACVP+C model, we examine the impact of firm characteristics on both stickiness and conservatism (panel A of Table 6). As expected (Hypothesis 2), even after controlling for the interaction of firm characteristics with conditional conservatism, they have the expected effect on stickiness: the sticky earnings differential is increasing with asset intensity (α_3=-0.020 for operating income and α_3=-0.021 for net income), increasing with employee intensity (α_4=-0.013 and α_4=-0.017, respectively) and decreasing with firm size (α_5=0.005 and α_5=0.005, respectively); all of these effects are significant at the 0.1 percent level. Consistent with our prior expectations, the degree of conditional conservatism increases with asset intensity (β_4=0.211 for operating income and β_4=0.240 for net income), increases with employee intensity (β_5=0.126 and β_5=0.130, respectively), and decreases with firm size (β_6=-0.032 and β_6=-0.029, respectively); all three variables are significant at the 0.1 percent level.

Similar to our earlier results without controls for firm characteristics, stickiness estimates (*SScore*) in the extended ACVP model are biased upwards relative to the adjusted stickiness scores (*Adj. SScore*) in the extended ACVP+C model (Hypothesis 3). The extended ACVP model overestimates the average (median) stickiness score *SScore* by 10.3 percent (8.1 percent) for operating income, and by 12.2 percent (10.3 percent) for net income;[31] all four biases are significant at the 0.1 percent level (panel B of Table 6). Thus, even after controlling for the observable determinants of stickiness, it is important to account for the confounding effect of

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[31] *Adj. SScore* in the extended ACVP+C model captures variation associated only with cost stickiness (and not the parallel variation in the conservatism part of the model); therefore, the adjusted *SScore* can be directly compared to the basic *SScore* in the extended ACVP model.

conservatism (using the extended ACVP+C model) to avoid upward bias in the stickiness estimates.

Based on Hypothesis 4, the estimated effect of firm characteristics on stickiness in the extended ACVP model should be biased due to lack of controls for their impact on conservatism (the extended ACVP+C model deals with this bias by incorporating the relevant controls). Consistent with this prediction, the extended ACVP model substantially overestimates the impact of asset intensity on stickiness, by 45 percent for operating income (α_3=-0.029 versus α_3=-0.020 in extended ACVP and ACVP+C, respectively), and by 48 percent for net income (α_3=-0.031 versus α_3=-0.021, respectively); both biases are significant at the 0.1 percent level (panel A of Table 6). It also dramatically overestimates the impact of employee intensity on stickiness, by 108 percent for operating income (α_4=-0.027 versus α_3=-0.013, respectively), and by 88 percent for net income (α_4=-0.032 versus α_3=-0.017, respectively); both differences are significant at the 0.1 percent level. The extended ACVP model also underestimates the impact of firm size on stickiness (the bias is insignificant for operating income but significant at the 1 percent level for net income). For both operating and net income, the direction of bias for all three variables is consistent with Hypothesis 4. Notably, these biases affect not only individual coefficient estimates but also the estimates of overall variation in stickiness scores. For example, the extended ACVP model overestimates the interquartile range of *SScore* by 50 percent for operating income and by 48 percent for net income, compared to variation in the adjusted *SScore* from the extended ACVP+C model.[32] Thus, adding controls for the impact of firm characteristics on conservatism is essential for generating accurate firm-year stickiness measures.

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[32] These percentages are computed as follows. For operating income, the interquartile range is equal to 0.060-0.024=0.036 in the extended ACVP model versus 0.049-0.025=0.024 in the extended ACVP+C model (panel B of Table 6), which corresponds to a 50 percent difference. For net income, the interquartile range is 0.065-0.025=0.040 in extended ACVP versus 0.053-0.026=0.027 in extended ACVP+C, which represents a 48 percent difference.

4.3. Out-of-sample performance of alternative CVP models

To evaluate the out-of-sample performance of our modified models versus standard CVP, we estimate the parameters of each model on a 5-year rolling window from year *t-5* to year *t-1*, and use the estimates to generate CVP earnings benchmarks for year *t* conditional on concurrent realized sales.[33] The timing and information structure in this test follows practical applications of CVP, which use historical cost structure estimates available at the beginning of period *t* to evaluate different scenarios for year *t* sales. We repeat this procedure for each year in our sample (i.e., we use a rolling window from 1980-84 to generate earnings benchmarks for year 1985, a rolling window from 1981-85 to generate benchmarks for year 1986, etc). We measure model accuracy using the absolute forecast error (AFE), computed as the absolute value of the difference between actual earnings (scaled by lagged sales) and the CVP earnings benchmark generated by the respective model.

The average and median AFE for different models are presented in Table 7.[34] For operating income, standard CVP (the SCVP model) has the highest mean and median AFE among all models. Adding controls for cost stickiness (the ACVP model) reduces average (median) AFE by 0.4 (0.6) percent; the improvement in AFE is statistically significant at the 1 percent level.[35]

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[33] CVP is designed to project earnings *at a given level* of concurrent sales; therefore, the appropriate metric of out-of-sample performance is based on earnings benchmarks conditional on concurrent actual sales.

[34] We follow the sample selection criteria described in section 3. We further restrict the sample to firms that had no missing or invalid observations during the 5-year estimation window, and exclude observations with extreme levels of earnings (defined as earnings above 50% or below -50% of sales). Because we have only 5 observations per firm within each estimation window, we do not estimate the firm fixed effects (the rest of parameters are common to all firms and, therefore, can be estimated accurately from the 5-year pooled sample).

[35] The earnings benchmark in the ACVP model is computed conditional on both sales level $SALES_{i,t}$ and sales decrease dummy $SD_{i,t}$. However, because $SALES_{i,t}$ (combined with the known value of $SALES_{i,t-1}$) is sufficient to deduce $SD_{i,t}$, the ACVP model does not rely on any additional information that was not available in the SCVP model (i.e., both models use the same information, but ACVP uses it more efficiently). Because the ACVP model includes an additional independent variable relative to SCVP, it mechanically has higher R^2 within the estimation sample;

Adding controls for conditional conservatism (the ACVP+C model) further improves average (median) AFE, by 2.5 (2.1) percent relative to SCVP, and by 2.1 (1.5) percent relative to ACVP; all AFE improvements are significant at the 1 percent level.[36] Thus, both stickiness and conservatism are important for obtaining more accurate CVP earnings benchmarks.

In the extended ACVP and ACVP+C models, we add beginning-of-year firm characteristics (asset intensity, employee intensity and firm size), which affect stickiness (in both models) and conservatism (in extended ACVP+C). The inclusion of firm-level variables dramatically improves the accuracy of earnings benchmarks relative to the parallel model without firm characteristics: the average (median) AFE decreases by 8.8 (11.1) percent in extended ACVP relative to basic ACVP, and by 8.9 (10.9) percent in extended ACVP+C relative to basic ACVP+C. The improvement relative to standard CVP (the SCVP model) is even larger: 9.1 (11.7) percent for the extended ACVP model, and 11.1 (12.8) percent for the extended ACVP+C model. Therefore, in generating CVP-type earnings benchmarks, it is important to account for the observable drivers of variation in both stickiness and conservatism.

The results for net income (the last two columns in Table 7) are generally similar: adding controls for stickiness and conservatism improves AFE,[37] and the inclusion of controls for observable determinants of stickiness and conservatism leads to further significant improvement in the accuracy of CVP earnings benchmarks.

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however, this additional variable will improve out-of-sample AFE *only if* it contains meaningful incremental information about earnings.

[36] Following the general logic of CVP-type projections, the earnings benchmarks in the ACVP+C model are computed conditional on both realized $SALES_{i,t}$ and realized returns $RET_{i,t}$. Although the inclusion of returns mechanically improves fit within the estimation window, it does not necessarily reduce out-of-sample AFE; AFE will improve only if returns contain a sufficiently large amount of useful incremental information.

[37] The only exception is median AFE in basic ACVP and ACVP+C models, which is slightly higher than that in SCVP. However, because OLS is designed to minimize average (rather than median) deviations, median AFE is a less reliable metric of model accuracy than is average AFE (average AFE in the ACVP and ACVP+C models is significantly lower compared to that in SCVP).

4.4. Additional validity checks

To verify that our empirical approach successfully separates cost stickiness from conditional conservatism, we re-estimate our models for the number of employees (the one widely available measure of physical resource levels in Compustat). As discussed in section 2, because stickiness represents asymmetry in real resource commitments, we expect to observe stickiness both for financial variables and for physical resource measures. By contrast, because conditional conservatism is relevant only in financial reporting, we do not expect to detect conservatism for physical resource levels. The estimates are presented in panel A of Table 8. Consistent with our predictions, the estimates of cost stickiness for the number of employees are significant both statistically and economically (α_2=0.043, t=8.92[38]), whereas the estimates of conditional conservatism are statistically insignificant and close to zero (β_3=-0.010, t=-0.64). Notably (and unlike the results for earnings in Table 5), stickiness estimates for the number of employees in the ACVP model are virtually identical to those in the ACVP+C model; the difference between them is statistically insignificant (χ^2=0.42, df=1). This supports our argument that the bias in the ACVP stickiness estimates is due to conditional conservatism (Hypothesis 3): conservatism distorts the estimates for earnings as documented in Table 5 but does not (and should not) distort the estimates for the number of employees. These findings further confirm that our empirical models successfully distinguish stickiness from conservatism. More broadly, they suggest that in studies based on reported accounting data, it is essential to control for conservatism even when the research question is in a seemingly unrelated area (such as cost behavior).

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[38] The mean number of employees (scaled by lagged sales) is 1.32. Therefore, the sticky earnings differential α_2=0.043 is equivalent to 0.043/1.32=3.3% of the mean number of employees. In other words, when sales decrease, an average firm retains unutilized labor equal to 3.3% of its total work force. The predicted sign of α_2 for the number of employees is positive (the opposite of that for earnings), indicating higher costs for the same sales level.

In additional sensitivity analyses, we replace our main specification of stickiness (defined for the level of earnings) with the conventional ABJ stickiness (defined for log-changes in costs). The estimates for log-changes in operating and total costs (the counterparts of operating and net income in our main models) are presented in panel B of Table 8. Similar to the findings for our main models, the estimates for the ABJ-type specifications support our theoretical predictions. Specifically, for both operating and total costs, we observe significant stickiness ($\alpha_2<0$, Hypothesis 1) and significant conservatism ($\beta_3<0$).[39] As expected, adding controls for ABJ stickiness increases the estimates of variable costs (from $\alpha_1=0.787$ to $\alpha_1=0.850$ for operating costs, and from $\alpha_1=0.797$ to 0.872 for total costs; both differences are significant at the 0.1 percent level). Thus, the standard cost model (i.e., the log-change counterpart of the SCVP model) suffers from omitted variable bias because it does not control for cost stickiness. Consistent with Hypothesis 3, adding controls for conditional conservatism in ABJ-type models reduces the estimates of stickiness (from $\alpha_2=-0.176$ to $\alpha_2=-0.154$ for operating costs, and from $\alpha_2=-0.209$ to -0.179 for total costs; both differences are significant at the 0.1 percent level). Therefore, even after controlling for stickiness using the ABJ specification, it is essential to account for conditional conservatism to avoid bias in cost structure estimates. In untabulated additional robustness checks for ABJ-type models, we interact both stickiness and conservatism with firm characteristics (asset intensity, employee intensity and firm size). Consistent with the findings for our main models, the degree of cost stickiness in ABJ-type analysis is increasing with asset and employee intensity and decreasing with firm size (Hypothesis 2), and these variables also significantly affect conservatism. Furthermore, it is essential to control for the

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[39] Unlike the stickiness parameters in our main models, the stickiness coefficient α_2 in the log-change models has the conventional ABJ interpretation as asymmetry in slopes, and is expected to be negative as in ABJ. The predicted sign of the conservatism coefficient β_3 for costs is negative.

interactions of these variables with both stickiness and conservatism to avoid distorted estimates of their impact on cost stickiness (Hypothesis 4).[40]

5. Conclusion

In this study, we examined the implications of cost stickiness and conditional conservatism for CVP analysis. We argued that the prevalence of cost stickiness requires revisiting the very foundations of CVP. We built on the theory of sticky costs to develop the "asymmetric CVP" (ACVP) framework based on managerial discretion and resource adjustment costs. In contrast to standard CVP, the asymmetric CVP relation is described by two distinct earnings lines: the upper ACVP line represents earnings behavior only in the case of increasing sales, whereas the lower ACVP line is relevant when sales are decreasing. The vertical gap between the two ACVP lines reflects the cost of slack resources retained by managers when sales drop. Sales changes in the ACVP framework affect earnings not only through variation in the contribution margin (as in standard CVP), but also – and potentially more important – through asymmetric retention of slack resources. We showed that our ACVP framework leads to major conceptual changes in many applications of CVP (such as breakeven analysis and the use of operating budgets for planning and control). We also showed that both cost stickiness and conditional conservatism are likely to distort external analysts' cost structure estimates, leading to systematic bias in inferences drawn from CVP. We proposed alternative empirical models that directly incorporate stickiness and conservatism in ACVP estimation.

Using Compustat/CRSP data for 1979-2007, we found that incorporating cost stickiness has a strikingly large impact on CVP-type inferences. For the same current sales level, earnings are

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[40] As an aside, our results suggest that future cost accounting studies that rely on the ABJ model and its extensions should control for conditional conservatism and its interactions with firm characteristics to avoid potentially important biases.

dramatically lower when sales decrease (rather than increase) to this level from the prior period. The difference between the two earnings benchmarks (i.e., the vertical distance between the two ACVP lines, holding sales constant) is equivalent to 47 percent of median operating income and 96 percent of median net income. This is in stark contrast to standard CVP, which *assumes* (without any empirical validation) that the two benchmarks are identical. Notably, the impact of sales changes on earnings via the contribution margin (the only channel captured by standard CVP) is equivalent to just 10-39 percent of the impact of sales decreases on earnings via retained slack resources (the additional channel at the core of ACVP). The impact of cost stickiness on earnings is highly heterogeneous across firms; our stickiness score (*SScore*) methodology provides firm-specific estimates of this heterogeneity that can be used in practical applications of ACVP.

The ACVP estimates reveal the need for important revisions in many CVP benchmarks. For example, the ACVP breakeven point is substantially higher (by an equivalent of 62 percent of lagged sales) for a firm with decreasing sales compared to an identical firm with increasing sales; therefore, the standard CVP breakeven benchmark (which is constrained to be the same for both firms) is useful neither for a firm with growing sales nor for a firm with shrinking sales.

We also found that, even though conservatism is usually ignored in cost accounting, it has a sizable confounding effect on CVP estimates. For example, without controls for conservatism, the ACVP stickiness estimates would be biased upwards by 11 to 14 percent, and the estimated impact of firm characteristics on stickiness would be biased by up to 108 percent. More broadly, our findings indicate that incorporating recent research insights on economic and reporting asymmetries in earnings behavior leads to major conceptual and quantitative revisions in some of the most established (and widely used) cost accounting tools.

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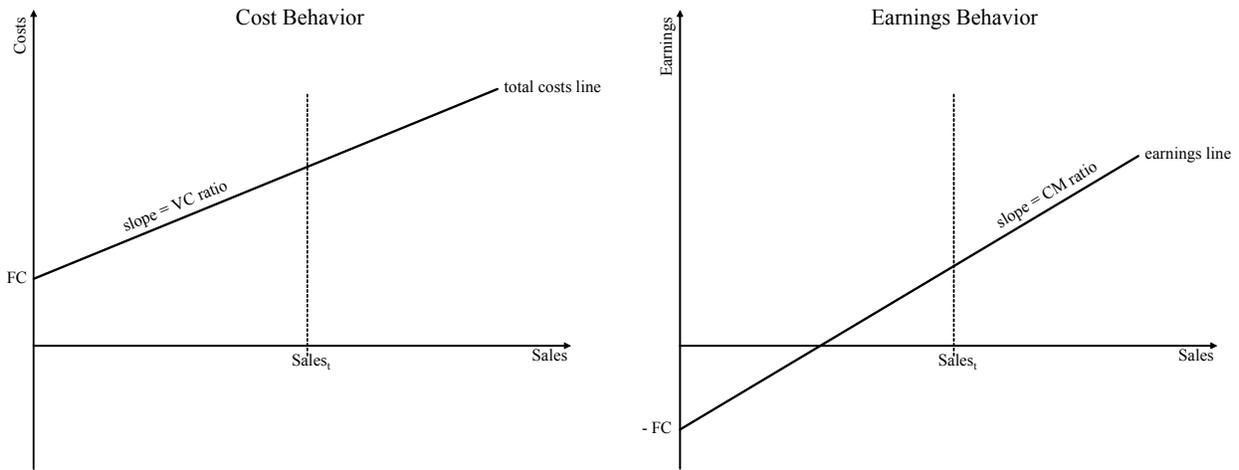
Panel A: Standard CVP (SCVP) relation
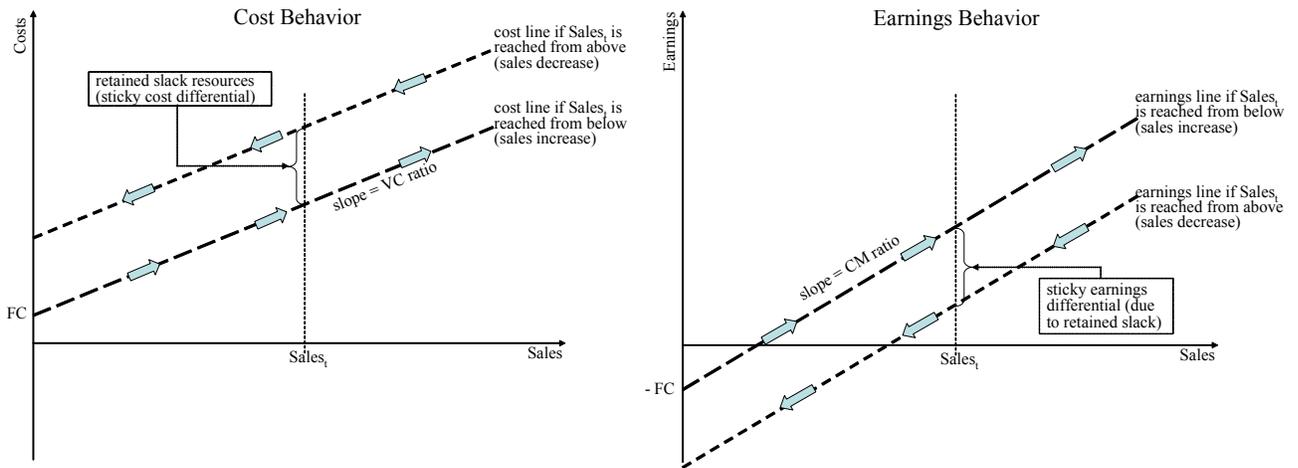
Panel B: Asymmetric CVP (ACVP) relation

Figure 1. Standard versus asymmetric CVP relation

Sales is specified as sales revenue in dollars (rather than volume in units) for consistency with our empirical models.
VC ratio = total variable costs / sales. CM ratio = total contribution margin / sales = 1 – VC ratio.
Because earnings = sales – costs, the intercept for earnings is equal to the negative of the intercept for costs, and the slope for earnings is equal to 1 less the slope for costs.
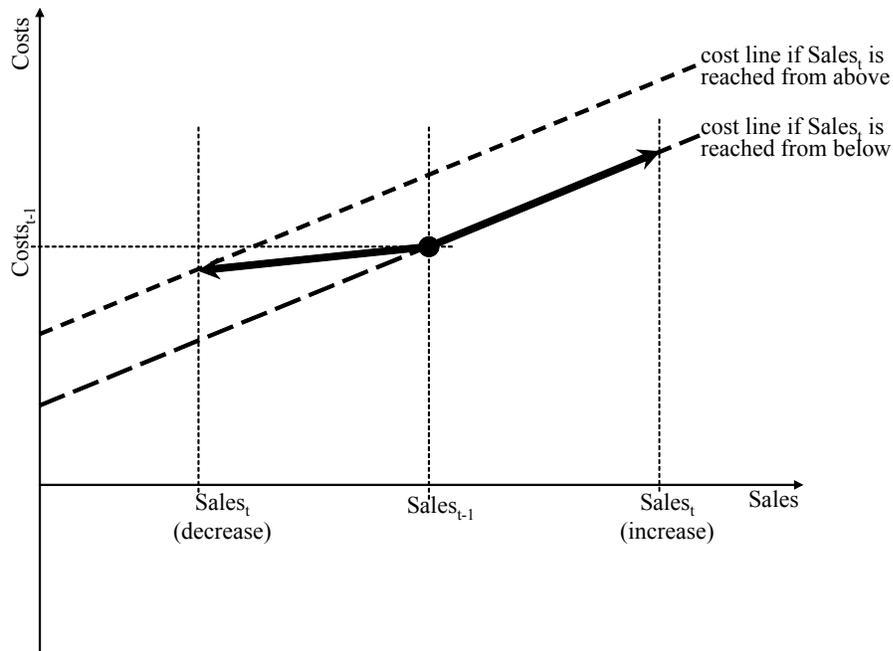
Panel A: ABJ stickiness when prior period costs are near the lower total costs line
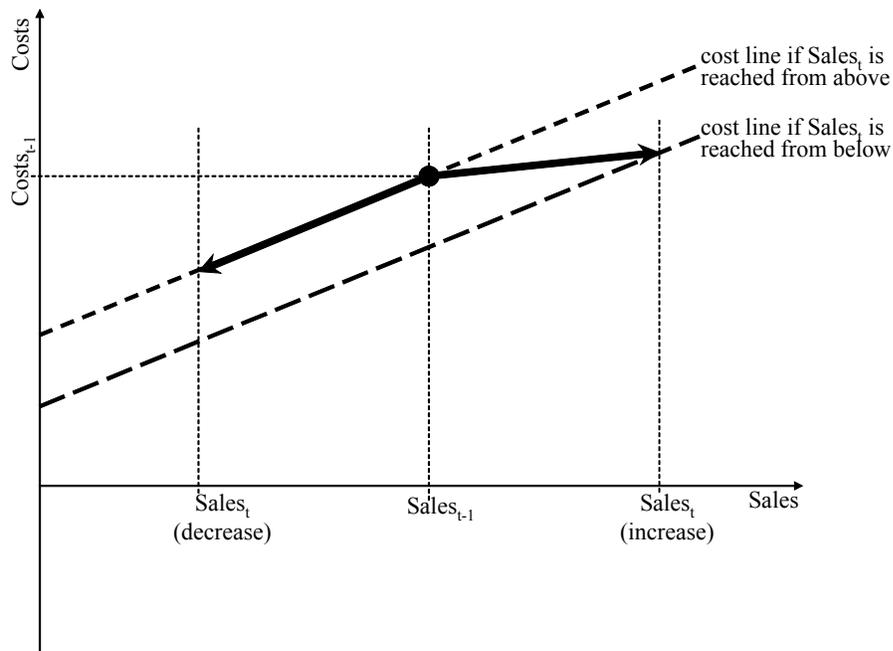
Panel B: Anti-stickiness when prior period costs are near the upper total costs line
(the *levels* of sales and costs in current period *t* are identical to Panel A).

Figure 2. The connection between ACVP stickiness in levels and ABJ stickiness
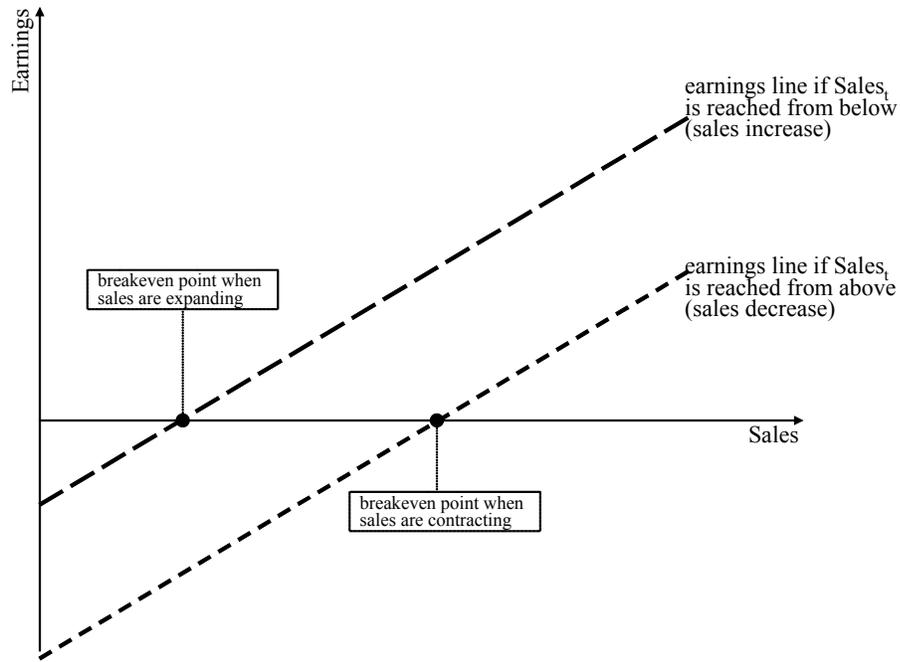
Figure 3. Breakeven analysis in asymmetric CVP
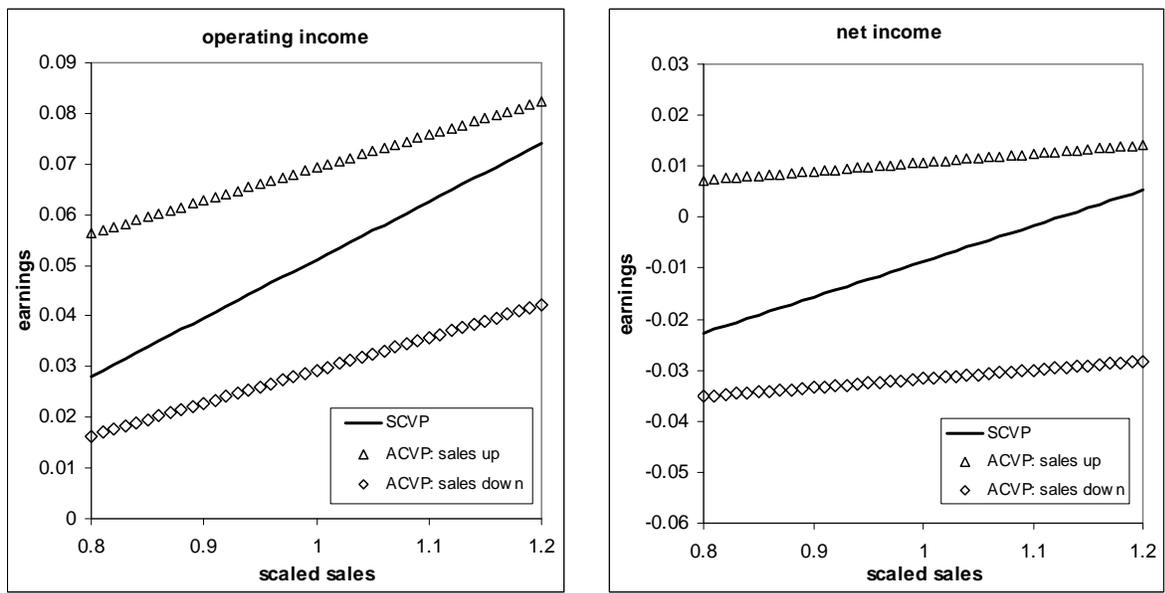
Figure 4. Standard CVP (SCVP) and asymmetric CVP (ACVP) relations based on the estimates from Table 3.
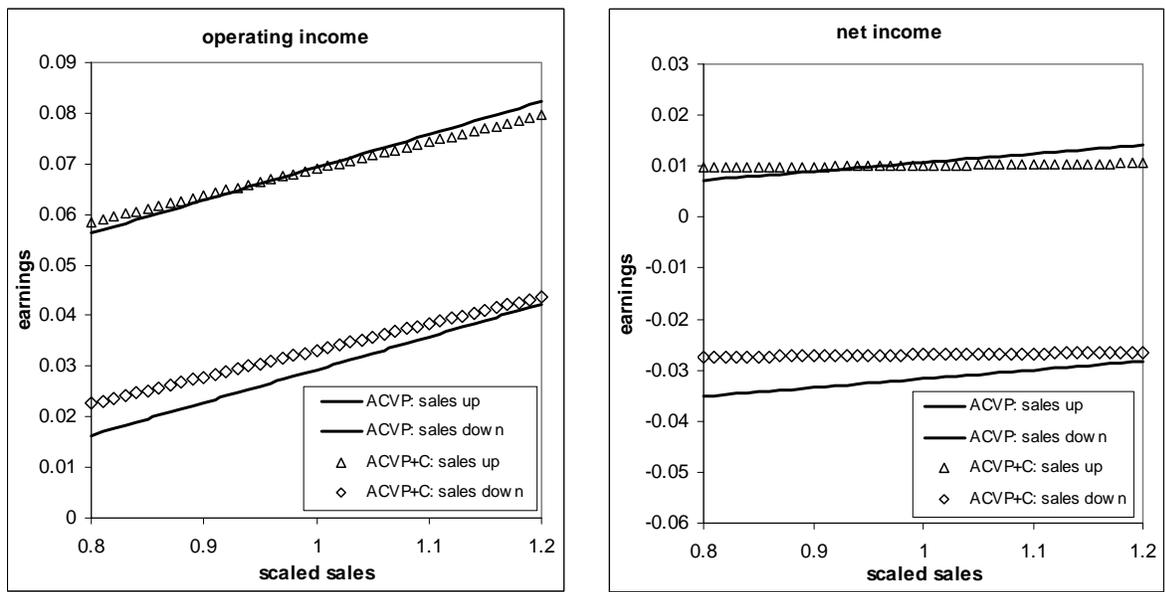
Figure 5. Asymmetric CVP relation with and without controls for conditional conservatism (ACVP and ACVP+C, respectively) based on the estimates from Table 5.

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Table 1. Variable definitions

$EARN_{i,t}$ – earnings (operating income $OI_{i,t}$ or net income $NI_{i,t}$) of firm i in year t.

$OI_{i,t}$ – operating income of firm i in year t (Compustat item OIADP).

$NI_{i,t}$ – net income of firm i in year t (Compustat item NI).

$SALES_{i,t}$ – net sales revenue (Compustat item SALE) of firm i in year t.

$SD_{i,t}$ – sales decrease dummy for firm i in year t, equal to 1 if $SALES_{i,t}<SALES_{i,t-1}$ and zero otherwise.

$AINT_{i,t}$ – asset intensity for firm i in year t, computed as the natural logarithm of the ratio of total assets to sales (Compustat items AT/SALE).

$EINT_{i,t}$ – employee intensity for firm i in year t, computed as the natural logarithm of the ratio of the number of employees to sales (Compustat items EMP/SALE).

$SIZE_{i,t}$ – size of firm i in year t, computed as the natural logarithm of end-of-year market value of the firm (Compustat items PRCC_F×CSHO).

$RET_{i,t}$ – stock returns of firm i during the 12-month period of fiscal year t (CRSP item Ret).

$DR_{i,t}$ – negative returns dummy for firm i in year t, equal to 1 if $RET_{i,t}<0$ and zero otherwise.

Table 2. Descriptive statistics

Panel A: Univariate statistics

	mean	s.d.	Q1	median	Q3
OI/SALES$_{t-1}$	0.061	0.349	0.029	0.085	0.166
NI/SALES$_{t-1}$	-0.003	0.346	0.005	0.044	0.093
SALES/SALES$_{t-1}$	1.088	0.241	0.962	1.052	1.168
SD	0.347	0.476	0.000	0.000	1.000
AINT	0.194	0.930	-0.425	-0.043	0.570
EINT	-4.651	0.719	-5.051	-4.609	-4.220
SIZE	4.815	1.867	3.384	4.711	6.150
RET	0.103	0.476	-0.203	0.041	0.310
DR	0.456	0.498	0.000	0.000	1.000

Panel B: Correlation matrix

	OI/ SALES$_{t-1}$	NI/ SALES$_{t-1}$	SALES/ SALES$_{t-1}$	SD	AINT	EINT	SIZE	RET	DR
OI/SALES$_{t-1}$	–	**0.939**	0.006	**-0.107**	-0.012	**-0.207**	**0.162**	**0.110**	**-0.130**
NI/SALES$_{t-1}$	**0.864**	–	-0.032	-0.082	**-0.119**	**-0.183**	**0.118**	**0.113**	**-0.124**
SALES/SALES$_{t-1}$	**0.323**	**0.304**	–	**-0.609**	0.083	0.088	0.027	**0.189**	**-0.123**
SD	**-0.303**	**-0.292**	**-0.825**	–	-0.039	-0.058	-0.098	**-0.178**	**0.155**
AINT	**0.360**	**0.252**	0.079	-0.044	–	**-0.150**	**0.187**	-0.014	-0.043
EINT	**-0.208**	**-0.185**	0.075	-0.059	**-0.177**	–	**-0.245**	-0.015	0.047
SIZE	**0.372**	**0.315**	0.066	**-0.101**	**0.230**	**-0.260**	–	-0.037	-0.057
RET	**0.288**	**0.312**	**0.207**	**-0.189**	0.001	-0.040	0.025	–	**-0.708**
DR	**-0.262**	**-0.278**	**-0.158**	**0.155**	-0.025	0.051	-0.058	**-0.863**	–

Pearson (Spearman) correlations are reported above (below) the diagonal. Numbers in bold typeface are significant at the 5 percent level.

Table 3: Standard and asymmetric CVP estimates

SCVP model (standard CVP relation)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \varepsilon_{i,t}$$

ACVP model (asymmetric CVP relation)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} + \eta_{i,t}$$

where $EARN_{i,t}$ is earnings (operating or net income) of firm i in year t, $SALES_{i,t}$ is sales revenue, and $SD_{i,t}$ is a sales decrease dummy.

	Exp. sign	operating income		net income	
		SCVP	ACVP	SCVP	ACVP
Intercept		-0.064***	0.004	-0.079***	-0.007
(α_0)		(-18.24)	(0.94)	(-21.07)	(-1.31)
SALES/SALES$_{t-1}$	+	0.115***	0.065***	0.070***	0.017***
(α_1)		(36.42)	(16.56)	(20.74)	(4.11)
SD	–		**-0.040*****		**-0.042*****
(α_2)			**(-21.16)**		**(-20.93)**
firm FE		yes	yes	yes	yes
Adj. R^2 (within)		1.77%	2.37%	0.58%	1.17%
Test statistics:					
$\alpha_{0(SCVP)} = \alpha_{0(ACVP)}$		χ^2=2,046.5***		χ^2=1,737.3***	
$\alpha_{1(SCVP)} = \alpha_{1(ACVP)}$		χ^2=182.60***		χ^2=194.50***	

The numbers in parentheses are the t-statistics. *, ** and *** indicate significance at 10, 5 and 1 percent level, respectively. The intercept α_0 represents the average of the firm fixed effects.

Table 4. Asymmetric CVP estimates with controls for firm characteristics

Extended ACVP model (asymmetric CVP relation with controls for firm characteristics)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + (\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1})SD_{i,t} + \varsigma_{i,t}$$

where $EARN_{i,t}$ is earnings (operating or net income) of firm i in year t, $SALES_{i,t}$ is sales revenue, $SD_{i,t}$ is a sales decrease dummy, $AINT_{i,t}$ is asset intensity, $EINT_{i,t}$ is employee intensity, and $SIZE_{i,t}$ is firm size.

Panel A: Point estimates

	Exp. sign	operating income	net income
		ext. ACVP	ext. ACVP
Intercept		0.006	-0.005
(α_0)		(1.26)	(-1.04)
SALES/SALES$_{t-1}$	+	0.064***	0.016***
(α_1)		(16.26)	(3.90)
SD	–	-0.043***	-0.046***
(α_2)		(-22.83)	(-22.67)
AINT×SD	–	**-0.029*** **	**-0.031*** **
(α_3)		**(-17.07)**	**(-17.08)**
EINT×SD	–	**-0.027*** **	**-0.032*** **
(α_4)		**(-12.50)**	**(-13.70)**
SIZE×SD	+	**0.004*** **	**0.004*** **
(α_5)		**(5.30)**	**(5.01)**
firm FE		yes	yes
Adj. R^2 (within)		2.93%	1.78%

The numbers in parentheses are the t-statistics. *, ** and *** indicate significance at 10, 5 and 1 percent level, respectively. The intercept α_0 represents the average of the firm fixed effects. To facilitate the interpretation of α_2, we normalize the mean of the firm characteristics AINT, EINT and SIZE to zero. After this transformation, the coefficient α_2 captures the sticky earnings differential at the mean values of firm characteristics. This transformation does not affect the coefficients α_3-α_5 on firm characteristics.

Panel B: Descriptive statistics for the firm-year stickiness scores (SScore)

The firm-year stickiness scores are based on the point estimates from panel A and are computed as

$$SScore_{i,t} = -(\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1})$$

	mean	s.d.	Q1	median	Q3
SScore for operating income	0.043	0.032	0.024	0.040	0.060
SScore for net income	0.046	0.035	0.025	0.043	0.065

Table 5. Asymmetric CVP estimates without and with controls for conditional conservatism

ACVP model (asymmetric CVP relation)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} + \eta_{i,t}$$

ACVP+C model (asymmetric CVP relation with conservatism)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} +$$

$$+ \beta_1 DR_{i,t} + \beta_2 RET_{i,t} + \beta_3 DR_{i,t} RET_{i,t} + \upsilon_{i,t}$$

where $EARN_{i,t}$ is earnings (operating or net income) of firm i in year t, $SALES_{i,t}$ is sales revenue, $SD_{i,t}$ is a sales decrease dummy, $RET_{i,t}$ is stock returns, and $DR_{i,t}$ is a negative returns dummy.

	Exp. sign	operating income		net income	
		ACVP	ACVP+C	ACVP	ACVP+C
Intercept		0.004	0.022***	-0.007	0.017***
(α_0)		(0.94)	(4.51)	(-1.31)	(3.20)
SALES/SALES$_{t-1}$	+	0.065***	0.053***	0.017***	0.002
(α_1)		(16.56)	(13.42)	(4.11)	(0.55)
SD	–	**-0.040***	**-0.036***	**-0.042***	**-0.037***
(α_2)		**(-21.16)**	**(-19.04)**	**(-20.93)**	**(-18.42)**
DR			0.008***		0.013***
(β_1)			(3.76)		(5.76)
RET			0.019***		0.018***
(β_2)			(8.25)		(7.39)
DR×RET	+		**0.092***		**0.138***
(β_3)			**(14.75)**		**(20.67)**
firm FE		yes	yes	yes	yes
Adj. R^2 (within)		2.37%	3.47%	1.17%	2.77%
Test statistics:					
$\alpha_{2(ACVP)} = \alpha_{2(ACVP+C)}$		χ^2=202.69***		χ^2=227.69***	
$\beta_{3(op.\ income)} = \beta_{3(net\ income)}$		χ^2=88.91***			

The numbers in parentheses are the t-statistics. *, ** and *** indicate significance at 10, 5 and 1 percent level, respectively. The intercept α_0 represents the average of the firm fixed effects.

Table 6. Estimates of the extended ACVP and ACVP+C models

Extended ACVP model (asymmetric CVP relation with controls for firm characteristics)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + (\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1})SD_{i,t} + \varsigma_{i,t}$$

Extended ACVP+C model (asymmetric CVP relation with conservatism and controls for firm characteristics)

$$\frac{EARN_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + (\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1})SD_{i,t} +$$

$$+ \beta_1 DR_{i,t} + \beta_2 RET_{i,t} + (\beta_3 + \beta_4 AINT_{i,t-1} + \beta_5 EINT_{i,t-1} + \beta_6 SIZE_{i,t-1})DR_{i,t} RET_{i,t} + \psi_{i,t}$$

where $EARN_{i,t}$ is earnings (operating or net income) of firm i in year t, $SALES_{i,t}$ is sales revenue, $SD_{i,t}$ is a sales decrease dummy, $AINT_{i,t}$ is asset intensity, $EINT_{i,t}$ is employee intensity, $SIZE_{i,t}$ is firm size, $RET_{i,t}$ is stock returns, and $DR_{i,t}$ is a negative returns dummy.

Panel A: Point estimates

	Exp. sign	operating income		net income	
		ext. ACVP	ext. ACVP+C	ext. ACVP	ext. ACVP+C
Intercept		0.006	0.009*	-0.005	0.002
(α_0)		(1.26)	(1.83)	(-1.04)	(0.36)
SALES/SALES$_{t-1}$	+	0.064***	0.066***	0.016***	0.017***
(α_1)		(16.26)	(17.04)	(3.90)	(4.18)
SD	–	-0.043***	-0.039***	-0.046***	-0.041***
(α_2)		(-22.83)	(-20.96)	(-22.67)	(-20.57)
AINT×SD	–	**-0.029*****	**-0.020*****	**-0.031*****	**-0.021*****
(α_3)		**(-17.07)**	**(-12.09)**	**(-17.08)**	**(-11.97)**
EINT×SD	–	**-0.027*****	**-0.013*****	**-0.032*****	**-0.017*****
(α_4)		**(-12.50)**	**(-6.01)**	**(-13.70)**	**(-7.28)**
SIZE×SD	+	**0.004*****	**0.005*****	**0.004*****	**0.005*****
(α_5)		**(5.30)**	**(5.44)**	**(5.01)**	**(5.95)**
DR			0.006***		0.011***
(β_1)			(2.68)		(4.97)
RET			0.019***		0.019***
(β_2)			(8.62)		(7.88)
DR×RET	+		0.089***		0.138***
(β_3)			(14.51)		(20.93)
AINT×DR×RET	+		**0.211*****		**0.240*****
(β_4)			**(43.58)**		**(46.58)**
EINT×DR×RET			**0.126*****		**0.130*****
(β_5)			**(23.46)**		**(22.70)**
SIZE×DR×RET	–		**-0.032*****		**-0.029*****
(β_6)			**(-13.74)**		**(-11.60)**
firm FE		yes	yes	yes	yes
Adj. R^2 (within)		2.93%	7.38%	1.78%	6.97%
Test statistics:					
$\alpha_{3(ACVP)} = \alpha_{3(ACVP+C)}$		χ^2=88.47***		χ^2=87.20***	
$\alpha_{4(ACVP)} = \alpha_{4(ACVP+C)}$		χ^2=112.09***		χ^2=115.19***	
$\alpha_{5(ACVP)} = \alpha_{5(ACVP+C)}$		χ^2=0.19		χ^2=6.79***	

The numbers in parentheses are the t-statistics. *, ** and *** indicate significance at 10, 5 and 1 percent level, respectively. The intercept α_0 represents the average of the firm fixed effects. To facilitate the interpretation of α_2 and β_3, we normalize the mean of the firm characteristics AINT, EINT and SIZE to zero. After this transformation, the coefficients α_2 and β_3 capture the sticky earnings differential and the degree of conditional conservatism, respectively, evaluated at the mean values of firm characteristics. This transformation does not affect the coefficients α_3-α_5 and β_4-β_6 on firm characteristics.

Panel B: Descriptive statistics for the firm-year stickiness scores without and with controls for conservatism (SScore and *Adj. SScore*, respectively*)*

The firm-year stickiness scores in both models are based on the point estimates from panel A and are computed as

$$SScore_{i,t} = -(\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1}) \text{ in extended ACVP model}$$

$$Adj.\,SScore_{i,t} = -(\alpha_2 + \alpha_3 AINT_{i,t-1} + \alpha_4 EINT_{i,t-1} + \alpha_5 SIZE_{i,t-1}) \text{ in extended ACVP+C model}$$

	mean	s.d.	Q1	median	Q3
Operating income:					
SScore (ACVP)	0.043	0.032	0.024	0.040	0.060
Adj. SScore (ACVP+C)	0.039	0.021	0.025	0.037	0.049
test: SScore vs Adj.SScore	t=104.65***	–	–	z=105.32***	–
Net income:					
SScore (ACVP)	0.046	0.035	0.025	0.043	0.065
Adj. SScore (ACVP+C)	0.041	0.024	0.026	0.039	0.053
test: SScore vs Adj.SScore	t=116.93***	–	–	z=116.12***	–

Table 7. Out-of-sample performance of alternative CVP models

	operating income		net income	
	mean AFE	median AFE	mean AFE	median AFE
SCVP	0.0680	0.0524	0.0477	0.0326
ACVP	0.0678	0.0520	0.0473	0.0329
ACVP+C	0.0618	0.0462	0.0455	0.0321
ext. ACVP	0.0663	0.0513	0.0460	0.0329
ext. ACVP+C	0.0605	0.0457	0.0441	0.0315
% difference in AFE relative to the SCVP model				
ACVP vs SCVP	-0.4%***	-0.6%***	-0.8%***	1.0%***
ACVP+C vs SCVP	-2.5%***	-2.1%***	-3.5%***	1.0%***
ext. ACVP vs SCVP	-9.1%***	-11.7%***	-4.6%***	-1.6%***
ext. ACVP vs SCVP	-11.1%***	-12.8%***	-7.5%***	-3.5%***
% difference in AFE in additional pairwise comparisons				
ACVP+C vs ACVP	-2.1%***	-1.5%***	-2.7%***	0.0%***
ext. ACVP vs ACVP	-8.8%***	-11.1%***	-3.8%***	-2.6%***
ext. ACVP+C vs ACVP+C	-8.9%***	-10.9%***	-4.1%***	-4.5%***

Table 8. Additional validity checks

Panel A: Estimates for the number of employees

SCVP model

$$\frac{EMP_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \varepsilon_{i,t}$$

ACVP model

$$\frac{EMP_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} + \eta_{i,t}$$

ACVP+C model

$$\frac{EMP_{i,t}}{SALES_{i,t-1}} = \alpha_{0,i} + \alpha_1 \frac{SALES_{i,t}}{SALES_{i,t-1}} + \alpha_2 SD_{i,t} +$$

$$+ \beta_1 DR_{i,t} + \beta_2 RET_{i,t} + \beta_3 DR_{i,t} RET_{i,t} + \upsilon_{i,t}$$

where $EMP_{i,t}$ is the number of employees for firm i in year t, $SALES_{i,t}$ is sales revenue, $SD_{i,t}$ is a sales decrease dummy, $RET_{i,t}$ is stock returns, and $DR_{i,t}$ is a negative returns dummy.

	Exp. sign	number of employees		
		SCVP	ACVP	ACVP+C
Intercept		0.114***	0.040***	0.040***
(α_0)		(12.92)	(3.37)	(3.26)
SALES/SALES$_{t-1}$	+	1.101***	1.155***	1.156***
(α_1)		(138.52)	(116.36)	(115.72)
SD	+		**0.043***	**0.043***
(α_2)			**(9.03)**	**(8.92)**
DR				-0.005
(β_1)				(-0.90)
RET				-0.006
(β_2)				(-1.06)
DR×RET				**-0.010**
(β_3)				**(-0.64)**
firm FE		yes	yes	yes
Adj. R^2 (within)		20.73%	20.82%	20.82%
Test statistics:				
$\alpha_{0(SCVP)} = \alpha_{0(ACVP)}$			χ^2=1,640.42***	
$\alpha_{1(SCVP)} = \alpha_{1(ACVP)}$			χ^2=48.24***	
$\alpha_{2(ACVP)} = \alpha_{2(ACVP+C)}$			χ^2=0.42	

The numbers in parentheses are the t-statistics. *, ** and *** indicate significance at 10, 5 and 1 percent level, respectively. The intercept α_0 represents the average of the firm fixed effects.

Panel B: Estimates of ABJ-type models for log-changes in costs

Log-change counterpart of the SCVP model (standard cost model)
$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \mu_{i,t}$$

Log-change counterpart of the ACVP model (ABJ stickiness model)
$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \alpha_2 SD_{i,t} \Delta \ln SALES_{i,t} + v_{i,t}$$

Log-change counterpart of the ACVP+C model (ABJ stickiness model with conservatism)
$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \alpha_2 SD_{i,t} \Delta \ln SALES_{i,t} +$$
$$+ \beta_1 RET_{i,t} + \beta_2 DR_{i,t} RET_{i,t} + \xi_{i,t}$$

where $\Delta lnCOST_{i,t}$ is the log-change in operating or total costs from year t-1 to year t for firm i, $\Delta lnSALES_{i,t}$ is the log-change in sales revenue, $SD_{i,t}$ is a sales decrease dummy, $RET_{i,t}$ is stock returns, and $DR_{i,t}$ is a negative returns dummy.

	Exp. sign	operating costs			total costs		
		log-change SCVP	log-change ACVP	log-change ACVP+C	log-change SCVP	log-change ACVP	log-change ACVP+C
Intercept		0.017***	0.005***	0.001**	0.018***	0.004***	-0.002***
(α_0)		(40.18)	(9.39)	(2.39)	(37.61)	(5.93)	(-2.93)
ΔlnSALES	+	0.787***	0.850***	0.858***	0.797***	0.872***	0.879***
(α_1)		(175.50)	(156.00)	(152.02)	(167.55)	(148.68)	(144.58)
SD×ΔlnSALES	−		**-0.176*****	**-0.154*****		**-0.209*****	**-0.179*****
(α_2)			**(-18.44)**	**(-15.99)**		**(-19.34)**	**(-16.52)**
RET				-0.018***			-0.018***
(β_1)				(-16.31)			(-12.17)
DR×RET	−			**-0.052*****			**-0.071*****
(β_2)				**(-16.74)**			**(-18.77)**
Adj. R^2		73.67%	74.10%	74.87%	65.51%	66.04%	66.95%

Test statistics:

$\alpha_{0(SCVP)} = \alpha_{0(ACVP)}$		χ^2=325.10***	χ^2=358.77***
$\alpha_{1(SCVP)} = \alpha_{1(ACVP)}$		χ^2=313.09***	χ^2=345.80***
$\alpha_{2(ACVP)} = \alpha_{2(ACVP+C)}$		χ^2=225.73***	χ^2=270.87***
$\beta_{2(op.\ costs)} = \beta_{2(total\ costs)}$		χ^2=53.71***	

The numbers in parentheses are the t-statistics. *, ** and *** indicate significance at 10, 5 and 1 percent level, respectively. The intercept α_0 represents the average of the firm fixed effects.