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Empirical Analysis of Asymmetric Cost Behavior

Lee, Joo Hyung

UNIVERSITY OF CALGARY

Empirical Analysis of Asymmetric Cost Behavior

by

Joo Hyung Lee

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Abstract

The dominant cost behavior model described in current management accounting textbooks is based on the classification of costs into fixed costs and variable costs. Although this cost behavior model provides insights about how costs behave in relation to the volume of production, it does not take into account managers' role in cost management as circumstances change over time. The focus of my dissertation is on the asymmetric cost behavior (ACB) model that relates changes in costs to changes in cost drivers between periods and considers the role of managers in decision-making. Based on prior ACB literature, my first study develops and estimates a model of operating cost behavior that includes two cost drivers: sales revenue as a volume of activity driver and property, plant, and equipment in use (PP&E) as a physical capacity driver. My study finds that changes in selling, general and administrative (SG&A) costs separate between the two cost drivers, and that the explanatory power of an asymmetric cost behavior model including a second capacity driver is significantly greater than the explanatory power of the single-driver cost behavior model.

In my second study, I document that cost asymmetry varies systematically across life-cycle stages in a manner that reflects the option value of future revenue changes. This indicates that managers' decisions whether to keep or release slack resources is conditional on firm circumstances and that managers appraise slack resources as real options. Managing cash flows is an important concern facing managers, especially in highly uncertain business environments. In my third study, I test whether operating cash outflows are sticky and find that they are. Also, I test whether stickiness in operating cash outflows is influenced by short-term financial constraints represented by the current ratio and find that it is. These findings contribute to the sticky costs literature by isolating changes in operating cash outflows associated with changes in revenue.

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Chapter 1. Introduction

Costs are fundamental to both financial and managerial accounting. My dissertation research provides innovative extensions to a growing research literature that examines how costs change with changes in sales activity. This recent research goes beyond the traditional models of cost behavior that describe mechanistic relations between costs and sales volume, such as the fixed and variable cost model, to recognize that managers face multiple pressures when making decisions that affect costs. A number of insights, including cost stickiness, have been developed based on an empirical model that relates changes in SG&A costs to changes in sales (Anderson, Banker, and Janakiraman, 2003).

My research is innovative on three dimensions. First, it expands the empirical cost behavior model to include a second cost driver in addition to sales. This improves the empirical specification and provides new insights about the behavior of SG&A costs. Second, it conditions the analysis of cost behavior on the life-cycle stage of the firm. This enables improved analysis of costs and estimation of earnings. Third, it provides a conceptual basis for evaluating cost asymmetry in more depth by considering limitations on managers' ability to adjust resources.

An important objective of my dissertation research is to contribute to accounting in practice. The recent studies on asymmetric cost behavior investigate firms' cost behavior by adopting a managerial decision-making view of how firm resources are adjusted in response to changes in demand. My dissertation considers managerial decisions to adjust resources for different types of firm resource commitments and different states of the business, allowing both scholars and practitioners to more completely understand the discrepancy between costs incurred in business practice and estimated costs based on traditional cost behavior models. Enabling more accurate prediction of costs and better forecasting of earnings permits firm stakeholders to monitor managers' performance and leads to improved decision making.

Background, Research Subjects, and Contributions

Costs represent the value of resources invested for firms' production or service. Therefore, understanding cost behavior is the foundation of not only management accounting but also financial accounting in the sense that the measurement of performance and reporting the results of operations to stakeholders starts from measuring costs as well as revenues. Recent studies have investigated asymmetry in cost behavior between sales up and sales down periods from an economic perspective that recognizes how resource adjustment costs and managers' optimism about future sales affect managers' decisions to retain or release slack resources (Anderson, Banker, and Janakiraman, 2003; Banker et al. 2014; Banker and Byzalov 2014). Before the discussion of asymmetric cost behavior, the behavior of costs had been regarded as systematic changes corresponding to changes in the volume of output or sales. The study of asymmetric cost behavior takes managers' role into account in examining firm cost behavior.

As indicated above, asymmetric cost behavior – driven by adjustment costs and managers' optimism – is about resource management. Cost stickiness occurs when managers deliberately retain slack resources resulting from a decline in sales activity. Managing resource strain and resource slack are key elements of successful business leadership (Cyert and March 1963; Bourgeois 1981; Meyer 1982; Tan and Peng 2003; Bradley et al. 2011). Resource strain occurs in periods when demand outpaces available resources and resource slack occurs in periods when available resources are not fully utilized in order to meet demand. Under conditions of stochastic demand and managers' bounded flexibility, managers may retain resource slack created by a drop in demand in order to ease anticipated resource strain caused by a subsequent jump in demand.

In the first piece of my dissertation I aim to expand the asymmetric cost behavior model by incorporating a different cost driver from changes in sales so as to link different types of firm resources to changes in firm activity and managerial decisions. According to the asymmetric cost behavior model, managers play an active role in determining cost behavior by adding or removing resources as activity changes. In this regard, I associate cost inertia with resources tied to long-term physical assets and estimate a model of cost behavior that includes two cost drivers: revenue as a volume of activity driver and property, plant and equipment (PP&E) as a capacity driver. The expectation from this research is to provide additional insight with an innovative cost behavior model, enabling information users to measure cost changes and to predict the use of firm resources more accurately (ABJ 2003; Balakrishnan et al. 2004).

The second part of my dissertation addresses the relation between the business context and asymmetric cost behavior. As shown in prior studies (Weiss 2010; Banker et al. 2014), depending on managers' expectations regarding future market – either optimistic or pessimistic – the magnitude of cost asymmetry varies. In evaluating the effect of managers' optimism versus pessimism on firm cost behavior, previous literature examines cost behavior based on consecutive sales decreases and sales increases. Yet to get deeper understanding of managers' expectations regarding future markets, additional information about different business circumstances affecting future sales are required. Addressing this concern, I investigate asymmetric cost behavior in different stages of firm life cycle.

The value of resource slack is likely to be dependent on firm life cycle for the following reasons. First, constraints on managers' decision making may be more binding for growth firms. Growth firms are companies that have entered new markets or have distinctive products – innovative firms are characterized by bundles of short life-cycle products. Managers of growth firms are less able to anticipate future resource needs than managers of firms in mature stages due to the complexity of the future comprised of potential combinations of resource requirements. Thus, managers of growth firms may find it necessary to carry more resources that are not dedicated to specific tasks (adaptable resources) than other firms.

A downturn in sales has different implications for innovative versus non-innovative firms because a drop in sales is more likely due to product fatigue for innovative firms as opposed to demand cycles, and sales recovery for such firms comes from substituting new products for declining products. Thus, innovative firms must redeploy resources to new products and markets in order to recover from a sales decline. From such rationale when studying asymmetry in cost behavior, empirical analysis that mixes different life-cycle stages may cause biases and misleading results. To mitigate this latent problem in empirical tests, I look at cost asymmetry across different firm life-cycles. This study aims to investigate differences in resource slack across life cycles based on the premise that resource slack is more valuable to growth companies that face greater uncertainty about business prospects.

Given that managers must add sufficient resources to support a sales increase, cost asymmetry between sales increase and sales decrease periods reflects managers` decisions to retain or release slack resources in periods when revenue declines. However, the focus of most prior studies in asymmetric cost behavior has been on accrual-based information such as selling, general, and administrative (SG&A) expenses and costs of goods sold (COGS). Even though such accrual-based costs are informative and reflect economic transactions, it is also useful to examine cash flows directly because managing cash is essential to firm survival and prosperity. Thus, the third piece of my dissertation addresses asymmetric cost behavior with respect to operating cash outflows. It is worthwhile to investigate cost behavior from a cash flow perspective because cash flow analysis can contribute to better comprehension of resource adjustments, leading to better decision making and cash flow management. In this study, I also consider how financial constraints affecting liquidity and solvency affect cost management decisions.

Chapter 2. Cost Stickiness and Cost Inertia

2.1. Abstract

In the models described in the asymmetric cost behavior literature, managers play an active role in determining cost behavior by adding or removing resources as activity changes. Cost stickiness occurs when managers deliberately retain slack resources resulting from a decline in sales activity between periods. Because changes in both sales and physical capacity may affect managers' decisions to adjust operating resource commitments, we estimate a model of operating cost behavior that includes two cost drivers: sales revenue as a volume of activity driver and property, plant and equipment in use (PP&E) as a physical capacity driver. We find that changes in selling, general and administrative (SG&A) costs separate between the two cost drivers, and that the explanatory power of an asymmetric cost behavior model including a second capacity driver is significantly greater than the explanatory power of the single-driver cost behavior model. We document downside asymmetry in cost changes related to changes in physical capacity that we label cost inertia. Cost inertia indicates that some resource commitments are sustained when physical capacity is reduced. Similar results are obtained when we replace SG&A costs with employee headcount or employee costs as the cost measure of interest. In all cases, we find that the cost inertia term is significantly negative and relatively large in magnitude. We estimate an expanded model that conditions analysis of current year cost behavior on the direction of sales change in the previous period and find that the pattern of cost changes is consistent with both cost stickiness and cost inertia.

2.2. Introduction

Traditional models of cost behavior relate changes in costs to changes in volume for a specific production system. Such models are mechanistic in the sense that they do not rely on managers to adjust resources based on observed demand – costs are assumed to be either fixed or variable with respect to the quantity produced. Recent innovations in cost analysis relate costs to resource commitments and recognize the role of managers who adjust resource commitments in response to changes in observed demand (Cooper and Kaplan 1992, Noreen and Soderstrom 1994). Insights about managers' decision-making under uncertainty are obtained by evaluating differences in cost behavior when activity decreases versus when activity increases (Anderson, Banker, and Janakiraman 2003 (ABJ); Banker and Chen 2006; Weiss 2010; Chen, Lu, and Sougiannis 2012; Dierynck, Landsman, and Renders 2012; Kama and Weiss 2013).

The fact that asymmetric cost behavior models are used to evaluate cost changes between periods makes them inherently different from traditional cost behavior models used to predict costs based on quantity produced within a period. From an inter-period perspective, non-volume cost drivers may also be relevant for explaining changes in operating costs between periods. For instance, levels of long-term physical capital used in production change across periods and physical capacity may itself be considered as an operating cost driver.[1] In this regard, a decision to open a new facility leads to new overhead costs that arise from operation of the facility itself, separate from the costs generated by the volume of production and sales. Additional overhead burden related to the facility, such as the plant or store manager's salary or incremental head-office costs for facility and product management, do not depend on the volume of production. On the

[1] In their analysis of sticky cost behavior, Balakrishnan et al. (2014) separate long-term investment decisions from operating decisions and hold long-term investments fixed between periods. Similarly, we treat long-term investment decisions as distinct from operating decisions but recognize that long-term investments themselves change across periods.

other hand, costs associated with the facility such as direct labor used in manufacturing or direct costs of servicing customers are volume-driven. Thus, the empirical asymmetric cost behavior (ACB) models that relate changes in operating costs to changes in sales across periods are not fully specified if physical capacity changes over time. Considering both volume and capacity drivers would enrich insights about managerial decision-making obtained from analysis of asymmetric cost behavior.

In this paper, we estimate a two-driver ACB model that includes property, plant and equipment in use (gross PP&E) as a second cost-driver representing demand for resources that support physical capacity managed and markets served.[2] We predict that cost changes separate between the two cost drivers and that the explanatory power of estimations made using both cost drivers is greater than the explanatory power of estimations made using a single cost driver. Our two-driver model accommodates asymmetry in cost changes related to increases and decreases in physical capacity, and we use the term "cost inertia" to describe downside asymmetry in cost behavior with respect to changes in capacity in the same way that "cost stickiness" is used to describe downside asymmetry in cost behavior with respect to changes in sales.

We begin our analysis by comparing single-driver and two-driver models of asymmetric cost behavior for selling, general and administrative (SG&A) costs, following much of the previous literature that analyzes SG&A cost behavior. For the single driver model, we find evidence of strong stickiness consistent with previous findings. From the estimation of the two-driver model, we find that SG&A costs separate between the two drivers and that the explanatory power of the two-driver model is higher than the explanatory power of the single-driver model.

[2] The conceptual underpinnings of our arguments are similar in vein to the development of alternative costing systems such as ABC, GPK, etc., that are built around the idea that the identification and inclusion of specific cost drivers for different cost pools in the cost allocation model leads to a more accurate allocation of costs.

We also find that stickiness is less pronounced in the two-driver model than in the single-driver model and that cost inertia is relatively strong.[3]

We next focus on cost behavior related specifically to labor resources. Analyzing a specific type of resource, such as labor, enables us to draw insights about the properties of cost stickiness and cost inertia that we could not obtain as clearly by analyzing a multi-faceted cost object such as SG&A costs. Labor resources make up a large portion of operating costs for many companies and have been studied previously in the context of asymmetric cost behavior (Anderson and Lanen 2009; Banker, Byzalov, and Chen 2013).[4] Importantly, as noted in our example above, some types of labor may be more strongly associated with volume and some types may be more strongly associated with physical capacity. Analyzing labor resource management also helps address an empirical concern with using PP&E as a cost driver – that depreciation may be asymmetrically related to increases or decreases in PP&E (Shust and Weiss, 2014).[5]

Managers have a variety of options for adjusting labor resources when product demand changes. When demand increases, they may utilize existing employees more fully through overtime or incentive plans, they may add temporary employees or increase part-time workers, and they may increase their full-time complement if they expect the increase in demand to persist. Similarly, when demand falls, they may reduce payments to full-time employees (less overtime or incentive pay), cut temporary and part-time workers, or lay off full-time employees. When laying people off, companies will typically release employees with less experience or lower productivity

[3] In our exposition, we use "stickiness" for asymmetry in cost behavior with respect to sales and "inertia" for asymmetry in cost behavior with respect to changes in physical capacity. The arguments supporting inertia are similar to those supporting stickiness so our analysis may be considered as an innovation in evaluating stickiness.
[4] In a Cobb-Douglas production function (Anderson and Lanen 2009), inputs to production are capital, labor and flow-through resources. Thus, a focus on labor as a primary resource that is adjusted in response to changes in volume and changes in capital is consistent with this type of production function.
[5] There is no clean method for removing depreciation and amortization from SG&A costs because depreciation and amortization is not reported separately for SG&A and cost of goods sold.

first. Companies that face high demand volatility are likely to optimize their programs for adding and subtracting labor resources in order to reduce adjustment costs.

All of this suggests that labor resources that vary with volume are likely to be flexible and exhibit low stickiness. Labor that is not volume-based that is added or released when physical capacity is acquired or disposed of is likely to be longer-term labor because of its association with long-term assets. Such labor is typically classified as overhead, as opposed to direct labor, for costing purposes and is more likely to be white-collar versus blue-collar labor. Because asset-based labor is more long-term oriented, it may be more specialized and have greater firm-specific human capital associated with it (managers, engineers, product designers), making adjustment costs (costs of adding or subtracting resources) higher. This suggests that labor costs that vary with physical capital separately from sales are likely to be less flexible and exhibit relatively high inertia.[6]

We first utilize employee headcount as a direct measure of labor resources. We estimate a two-driver model that relates changes in employee headcount to changes in sales and changes in gross PP&E across periods. We find that changes in labor resources separate between the two drivers and the two-driver model provides greater explanatory power than the single-driver model. We do not find stickiness in headcount with respect to sales changes, but we find evidence of inertia in headcount. These findings support the separation of labor cost pools in the asymmetric cost behavior model when multiple cost drivers are used.

Finally, we estimate single-driver and two-driver models of asymmetric cost behavior for employee costs based on a smaller sample of firms that disclose employee costs separately. Here

[6] In the oil and gas industry, for example, drilling crews are employed at high hourly rates when rigs are in use and laid off when rigs are idle. Rig managers are former drillers who are salaried and retained when rigs are idle. They make less money on an hourly basis but have more job stability. The drilling crews are volume-based and the rig managers are capacity-based employees.

we find that employee costs separate between the cost drivers and that the explanatory power of the model with two cost drivers is higher than the explanatory power of the model with a single cost driver. While we find evidence of cost stickiness with respect to sales changes in the single driver model, cost stickiness is less pronounced in the two-driver model. Consistent with the headcount results, cost inertia is relatively strong in the two-driver model.

Previous research has conditioned the analysis of asymmetric cost behavior on the direction of change in sales in the preceding period (Banker, Byzalov, Ciftci, and Mashruwala 2014) (BBCM). This research has demonstrated that cost stickiness is higher when sales increased in the prior period and that costs are on average anti-sticky when sales decreased in the prior period. These findings are consistent with greater stickiness when managers are more optimistic about future sales based on past sales. Failure to condition on managerial optimism in this way can lead to misleading interpretations of results of estimations of sticky costs models (Banker and Byzalov 2014). For each of the three measures of resources or costs described above (SG&A costs, employee headcount, and employee costs), we estimate single-driver and two-driver models that condition on the direction of prior-period sales following BBCM. In all cases, we find that cost changes separate between the two drivers and that the two-driver models have higher explanatory value than the single-driver models.

Overall, our findings support the use of multiple cost drivers in empirical asymmetric cost behavior models.[7] For our large sample analysis of a broad spectrum of firms, we document that cost changes separate between sales changes as a volume of activity driver and PP&E changes as a physical capacity driver representing assets managed and markets served. We also provide evidence that cost inertia is a separate force from cost stickiness. We suggest that the use of

[7] Balakrishnan et al. 2014 critique the log-log specification used by ABJ and suggest alternative specifications. As we describe later, our findings are robust to these alternative specifications.

multiple cost drivers would lead to improved specifications of empirical cost behavior models in both financial and managerial accounting research, and that additional insights about managerial decision-making can be drawn from models with multiple cost drivers. In our analysis, for instance, we find that labor is relatively flexible with respect to decreases in sales but exhibits strong inertia with respect to decreases in PP&E. Our findings of cost inertia indicate that companies retain slack resources when physical capital is reduced that may be redeployed to alternative uses such as development of new markets.

2.3. Background and Hypotheses

Cost behavior is a central topic in accounting that has implications for both managerial and financial accounting research and practice. Beginning with Cooper and Kaplan (1992) and Noreen and Soderstrom (1994), a growing body of literature highlights the inability of the traditional fixed and variable cost model to fully and accurately reflect the behavior of costs with changes in activity. ABJ document that costs are "sticky" by showing that the percentage increase in selling, general and administrative (SG&A) costs for an increase in sales is larger than the percentage decrease in SG&A costs for an equivalent decrease in sales.[8] A number of subsequent research studies have examined both the determinants and consequences of this asymmetric cost behavior.

While the traditional fixed and variable model portrays a mechanistic response of costs to changes in activity levels, the recent literature on asymmetric cost behavior highlights the central role of managerial discretion that affects how resources get managed and how costs are created or

[8] Previous literature (Malcom 1991) used the term "sticky costs" as an alternative to the term "lumpy costs" in the context of the fixed and variable costs model. Stickiness in this sense meant that such costs would stick when activity declined unless managers recognized that there were excess resources and removed them. Unlike the stickiness described by Anderson, Banker and Janakiraman (2003), the stickiness described by Malcom (1991) did not arise from adjustment costs or agency concerns.

removed. Asymmetry occurs when frictions affect managers' decisions to adjust resources upward and downward (ABJ; Banker and Byzalov 2014). From an economic perspective, managers' decisions take into account adjustment costs associated with acquiring or releasing resources, including both pecuniary costs such as severance payments and non-pecuniary costs such as loss of firm-specific human capital, in light of expectations of future demand for resources. When making decisions, managers are likely to consider the current levels of capacity utilization (Balakrishnan, Petersen, and Soderstrom 2004), optimism regarding future sales (BBCM), the influence of employment legislation (Banker, Byzalov, and Chen 2013), and the criticality of the business function (Balakrishnan and Gruca 2008). Given the central role of managers' decision making in determining the behavior of costs, managers' personal incentives are also likely to play an important role. Chen, Lu, and Sougiannis (2012) show that agency costs related to empire building affect cost stickiness, while Dierynck, Landsman, and Renders (2012) and Kama and Weiss (2013) show that cost stickiness is affected by decisions made by self-interested managers who have incentives to meet earnings targets.

Other studies examine the implications of asymmetric cost behavior for capital market participants. Banker and Chen (2006) and Anderson, Banker, Huang, and Janakiraman (2007) consider how the knowledge of asymmetric cost behavior improves earnings prediction models. Weiss (2010) and Ciftci, Mashruwala, and Weiss (2016) examine whether market participants including financial analysts and investors fully incorporate the implications of asymmetric cost behavior on future earnings.

The asymmetric cost behavior model is based on economic primitives that influence managers' decisions: resource adjustment costs and managers' expectations of current and future demand for resources (Banker and Byzalov 2014). From this perspective, the fixed and variable cost model may be treated as a special case of the asymmetric cost behavior model where the adjustment costs are assumed to be either so high that they preclude short-run changes in resource commitments (fixed costs) or negligible such that short-run changes are easily made or are mechanistically related to activity (variable costs). Under these assumptions, the fixed and variable costs model does not require managerial discretion once a production technology is established – predicted resource consumption in a period would be determined by the volume of production in that period. Of course, there are many resources that fall between these two extremes – adjustment costs are non-zero and significant so managers must make deliberate decisions whether to add or remove such resources in the short run.

Managerial decisions regarding resources in this latter group lead to asymmetry in cost behavior. To accommodate asymmetry in cost behavior (differences in resource adjustments for an increase in volume versus a decrease in volume), the assumptions of the fixed and variable costs model must be relaxed. The asymmetric cost behavior model permits a continuum of adjustment costs and allows for managerial discretion to keep or release resources based on managers' perceptions of the adjustment costs and expectations of the firm's future demand for those resources. By permitting managerial discretion, the asymmetric cost behavior model considers the possibility that managers' short-term decisions to acquire, retain or release resources are not mechanically determined by current period volume and may depend on the resource commitments made previously.[9]

It is important to distinguish between the conceptual cost behavior models described above and the empirical ACB models that have been estimated in the literature. Given the stochastic

[9] The involvement of managers in resource adjustment decisions also opens up the potential for agency concerns related to resource management. ABJ recognized this and subsequent research has investigated the influence of managers' self-interest on cost behavior (e.g. Chen et al. 2012; Dierynck et al. 2012; and Kama and Weiss 2013).

nature of demand, the conceptual question of interest is how managers' resource commitment decisions would vary across different demand realizations. To examine cost behavior empirically, the researcher must investigate how costs change under different circumstances. Therefore, the empirical ACB models relate cost changes between adjacent periods to changes in volume between periods. ABJ chose to use a log-log specification – log ratio of costs in *t* to costs in *t-1* regressed on log ratio of sales in *t* to sales in *t-1* – in order to reduce potential statistical problems and to enable interpretation of the coefficients as elasticities. The log changes model estimated by ABJ accommodates asymmetry in cost behavior by including an indicator variable for sales decrease periods that is interacted with the log ratio of sales. Thus, the empirical ACB model offers a means for investigating short-run asymmetry in cost behavior.

Balakrishnan, Labro, and Soderstrom (2014) observe that managers make long-term investment decisions that lead to fixed costs in the short run. They argue that these long-term investment decisions impact the ability of researchers to detect short-term cost management decisions. Balakrishnan et al. (2014) suggest that estimating an alternative percentage changes specification, scaling the dependent variable by lagged sales, and including control variables are ways to address this issue.[10] A feature of the Balakrishnan et al. (2014) analysis is the separation of long-term and short-term resource commitments. We also recognize that managers make resource commitments that have different planning horizons and consider implications of changes in long-term resource commitments for empirical analysis of operating cost behavior. Long-term investments are typically tied to physical capacity such as manufacturing plants, retail stores, or service facilities. Some operating costs associated with these long-term investments are not

[10] Banker and Byzalov (2014) respond to the concerns raised by Balakrishnan et al. (2014) and defend the use of the log-log specification from an empirical perspective. In untabulated work, we estimate percentage changes models and use lagged sales to scale the dependent variable. We compare the results from these alternative specifications with the log-log specification in our robustness section.

directly affected by changes in the volume of activity in the short run but they are affected by changes in the physical capacity managed.

Companies make new long-term resource commitments and unwind old resource commitments on a continuous basis. For instance, retail companies open new stores or close old stores, and manufacturing companies open new plants and close old plants. In addition, companies develop new product lines and eliminate old product lines. Relaxing the assumption that long-term resource commitments are fixed across periods raises an empirical issue not contemplated in previous literature on asymmetric cost behavior. Changes in operating costs between periods may be partially driven by changes in long-term resource commitments across periods. We address this concern.

Previous literature in management accounting has recognized the role of long-term resource commitments as cost drivers. In fact, the notion of activity-based costing (ABC) was developed from the observation that many activities and associated costs are not driven solely by volume of sales or production (Miller and Vollmann 1985; Cooper and Kaplan 1988). Consequently, cost behavior may be described more completely when cost changes are related to multiple cost drivers (Cooper and Kaplan 1988; Banker and Johnston 1993). The use of multiple cost drivers provides a means for relating resource expenditures to cost centers and cost objects, linking costs to the activities engaged in (Cooper and Kaplan 1991). As a result, using multiple cost drivers improves cost predictions and assignment of costs to different products or divisions (Cooper and Kaplan 1991). While the ABC concept was initially developed to allocate costs more precisely, the concept has been applied in several other contexts requiring a finer assignment of costs e.g., cost management decisions, budgeting, and variance analyses (Horngren, Datar, and Rajan 2015).

To facilitate the reporting of costs associated with different activities, Cooper and Kaplan (1991) describe a hierarchy of business activities. Activities are classified as unit-level, batch-level, product-sustaining, or facility-sustaining depending on the factors that influence when the activities take place. The facility-sustaining and product-sustaining costs are not directly related to the volume of production but to the facilities or products managed. Following the logic inherent in the ABC cost hierarchy, we include an additional capacity cost driver in the empirical cost changes model to investigate how changes in operating costs across periods are related to changes in long-term resource commitments. We choose the level of physical capacity represented by gross property, plant and equipment to represent long-term commitments related to facilities and product lines. Just as sales is comprised of sales from various locations and products, the level of gross PP&E is comprised of assets utilized to support production and sales from various business units. Changes in gross PP&E represent changes in assets managed.

We use gross PP&E instead of net PP&E because our interest is in assets in use. In this regard, net PP&E is distorted by accumulated depreciation – a fully depreciated plant that is still operating requires management. For instance, the physical capacity of an airline is represented by the fleet of airplanes that it operates. An increase in the size of the fleet would lead to an increase in operating costs such as fleet management and maintenance costs. To the extent that increasing the size of the fleet is associated with opening new markets, there would be new selling, administrative and overhead costs related to serving those markets. While some of those costs would be volume-driven, others would be capacity-driven (Banker and Johnston, 1993). Over time, newly purchased aircraft are depreciated, reducing the net PP&E value of these airplanes. However, the operating costs required to support these aircraft would not decrease as a result of this type of reduction in net PP&E. Thus, historical cost represented by gross PP&E serves as a better indicator of the support costs associated with physical capacity than net PP&E.

We estimate an empirical model that allows asymmetry in cost behavior along two dimensions between periods – (a) sales decrease periods versus sales increase periods, and (b) PP&E decrease periods versus PP&E increase periods. While the recent literature on asymmetric cost behavior has focused on the former, we believe that the latter can be incrementally informative about how resources are managed and descriptive about the associated cost behavior.

To discriminate between asymmetry associated with the volume of sales that is referred to as cost "stickiness" and asymmetry associated with changes in capacity, we call the second type of asymmetry cost "inertia". The term "inertia" is used to capture the tendency of resource commitments to continue when the primary cost driver is removed (as a train would continue to roll if the engine were shut down). Like "stickiness", inertia may occur for different types of reasons. Administrative overhead at head office that increases with the number of facilities under management may take time to unwind. "Empire builders" may prefer to retain higher levels of resource commitments once those resources have been acquired. Some have observed that managers are often growth-oriented and more inclined to be "builders" than "dismantlers". Managers may anticipate redeployment of resources that serviced a business unit if the business unit is closed. In this regard, a reduction in capacity may be part of a plan that includes new long-term investments – pruning capacity may lead to new growth.

Traditionally, cost behavior is about the relation between costs and volume of production in a period. The development of the empirical ACB model includes time as an element of cost behavior so that the question is how costs change with changes in volume between periods. This temporal dynamic is itself of interest because many types of analysis are time-dependent. For instance, forecasting costs based on expected sales or evaluating changes in costs based on realized sales are questions that are time-dependent. Given this interest in the time-dependent analysis of cost behavior, the development of a more comprehensive approach that incorporates both changes in volume and changes in physical capacity that drive costs provides a useful extension to the empirical ACB model.

Our first hypothesis examines whether the addition of gross PP&E as a second driver of cost behavior improves the specification of empirical asymmetric cost behavior models. Accordingly, we state this hypothesis as follows:

> *H1 (Two-drivers): Cost changes between periods depend on both changes in the level of sales and changes in capacity represented by gross PP&E.*

Adding and removing physical capital is natural in the life of a company. As new physical capital is acquired and capacity increased, the company's general administration and overhead is likely to grow as well. Cost inertia is likely to occur because such resources are not naturally dismissed when a facility is closed and these resources may be easily transferred to alternative uses. For instance, experienced employees may be retained because they have firm-specific value. We examine the presence of cost inertia in our second hypothesis, which is stated as follows:

> *H2 (Inertia): There is asymmetry in cost changes associated with increases versus decreases in gross PP&E.*

2.4. Empirical Models

Consistent with previous literature, we follow ABJ and BBCM by estimating a ratio and log specification to enhance comparability of the variables and to reduce potential heteroskedasticity. For comparative purposes, our analysis of the cost behavior models is as follows. First, we estimate a base model, either the ABJ model or BBCM model, that relates changes in one of the dependent variables – SG&A costs, number of employees, and employee costs – to changes in sales activity, and then we estimate an extension of the base model that relates changes in one of the dependent variables to changes in both sales volume and PP&E. We compare both sets of models to evaluate our hypotheses.

The basic ABJ specification for SG&A costs ($\ln \Delta SGA_{i,t}$), which is later modified for employee headcount ($\ln \Delta Emp_{i,t}$) or employee costs ($\ln \Delta Emc_{i,t}$), is presented as equation (1a), and an extended specification including "control" variables is presented as equation (1b). The base model with two cost drivers is labeled as equation (1c) and the extended model with two cost drivers is labeled as equation (1d). The dummy variable *DEC* is activated and takes a value of one when sales decrease between period *t-1* and *t*, otherwise it is 0. Similarly, the dummy variable *PPE_DEC* is activated when gross PP&E decreases between periods *t-1* and *t*. We use the Δ symbol throughout to represent the ratio of the value in the current period *t* to the value in the previous period as opposed to a simple first difference.

$$Y = \beta_0 + \beta_1 \, \Delta\ln SALES_{i,t} + \beta_2 \, DEC \;\; \Delta\ln \Delta SALES_{i,t} + \varepsilon_{i,t} \qquad (1a)$$

$$\begin{aligned} Y = \beta_0 &+ \beta_1 \, \Delta\ln SALES_{i,t} + \beta_2 \, DEC \;\; \Delta\ln SALES_{i,t} \\ &+\beta_5 \, DEC * \Delta\ln SALES_{i,t} * Succ\_DEC_{i,t} \\ &+\beta_6 \, DEC * \Delta\ln SALES_{i,t} * \ln Asset\_Int_{i,t} \\ &+\beta_7 \, DEC * \Delta\ln SALES_{i,t} * \ln Emp\_Int_{i,t} \\ &+\beta_8 \, DEC * \Delta\ln SALES_{i,t} * FCF + \varepsilon_{i,t} \end{aligned} \qquad (1b)$$

$$\begin{aligned} Y = \beta_0 &+ \beta_1 \, \Delta\ln SALES_{i,t} + \beta_2 \, DEC \;\; \Delta\ln SALES_{i,t} \\ &+ \beta_3 \, \Delta\ln PP\&E_{i,t} + \beta_4 PPE\_DEC \; \Delta\ln PP\&E_{i,t} + \varepsilon_{i,t} \end{aligned} \qquad (1c)$$

$$\begin{aligned} Y = \beta_0 &+ \beta_1 \, \Delta \ln SALES_{i,t} + \beta_2 \, DEC \;\; \Delta\ln SALES_{i,t} \\ &+ \beta_3 \, \Delta\ln PP\&E_{i,t} + \beta_4 PPE\_DEC \; \Delta\ln PP\&E_{i,t} \\ &+\beta_5 \, DEC * \Delta\ln SALES_{i,t} * Succ\_DEC_{i,t} \\ &+\beta_6 \, DEC * \Delta\ln SALES_{i,t} * \ln Asset\_Int_{i,t} \\ &+\beta_7 \, DEC * \Delta\ln SALES_{i,t} * \ln Emp\_Int_{i,t} \\ &+\beta_8 \, DEC * \Delta\ln SALES_{i,t} * FCF + \varepsilon_{i,t} \end{aligned} \qquad (1d)$$

where, $Y = \Delta\ln SGA_{i,t}, \Delta\ln Emp_{i,t}$ or $\Delta\ln Emc_{i,t}$ in all equations. The control variables in models (1b) and (1d), including successive sales decreases, asset intensity, employee intensity and free cash flows (FCF) are drawn from ABJ and Chen et al. (2012). The employee intensity variable '$DEC * \Delta\ln SALES_{i,t} * \ln Emp\_Int_{i,t}$' is not included in the employee headcount model because the dependent variable $\Delta\ln Emp_{i,t}$ is based on the number of employees.

We estimate the base ABJ model without "control" variables to simplify comparison of the single-driver and two-driver models. ABJ included a linear expansion of the sticky costs term to permit variation in the degree of stickiness across firms based on such things as asset intensity and employee intensity. The additional variables included in the expansion have been labeled "control" variables in studies that investigate factors that influence the degree of stickiness. A consequence of expanding the sticky costs term is that the coefficient on the basic sticky costs variable '$DEC\ \Delta\ln SALES_{i,t}$' cannot be evaluated as a measure of stickiness by itself. When the control variables are present, stickiness must be evaluated as the sum of the coefficient on the basic sticky cost variable and the coefficients on the control variables weighted by the mean values of the control variables. We also estimate and present the results of estimating the extended models with the control variables.

In equation (1a), changes in the dependent variable between consecutive periods are related only to changes in sales volume. Equation (1c) captures the changes in the dependent variable that are related to changes in both sales volume and PP&E. The estimated coefficients of PP&E, $\widehat{\beta_3}$, and interaction of PP&E decrease dummy and PP&E, $\widehat{\beta_4}$, in equation (1c) pick up changes in SG&A costs (or employee count or employee costs) that are associated with net changes in long-term physical capital represented by PP&E.

The second set of models, the BBCM model and its extension, are also presented. The BBCM model conditions on the direction of sales change in period *t-1* in order to distinguish periods where managers are likely to be more optimistic (following a sales increase in the previous period) or more pessimistic (following a sales decrease in the previous period). If sales decreased during the prior period, the dummy variable $D_{i,t-1}$ takes a value of 1, otherwise 0. Although not necessary empirically, we use the notation $I_{i,t-1}$ to designate periods following a sales increase. The remaining terms are as defined previously.

$$
\begin{aligned}
Y = \beta_0 &+ I_{i,t-1}\left(\beta_1\, \Delta\ln SALES_{i,t} + \beta_2\, DEC\;\; \Delta\ln SALES_{i,t}\right) \\
&+ D_{i,t-1}\left(\beta_3\;\; \Delta\ln SALES_{i,t} + \beta_4\, DEC\;\; \Delta\ln SALES_{i,t}\right) + \varepsilon_{i,t} \qquad \text{(2a)}
\end{aligned}
$$

$$
\begin{aligned}
Y = \;& I_{i,t-1}\left(\beta_1\, \Delta\ln SALES_{i,t} + \beta_2\, DEC\;\; \Delta\ln SALES_{i,t}\right) \\
&+ D_{i,t-1}\left(\beta_3\, \Delta\ln SALES_{i,t} + \beta_4\, DEC\;\; \Delta\ln SALES_{i,t}\right) \\
&+ I_{i,t-1}\left(\gamma_1\, \Delta\ln PP\&E_{i,t} + \gamma_2\, PPE\_DEC\, \Delta\ln PP\&E_{i,t}\right) \\
&+ D_{i,t-1}\left(\gamma_3\, \Delta\ln PP\&E_{i,t} + \gamma_4\, PPE\_DEC\;\; \Delta\ln PP\&E_{i,t}\right) + \varepsilon_{i,t} \qquad \text{(2b)}
\end{aligned}
$$

where, $Y = \Delta\ln SGA_{i,t}, \Delta\ln Emp_{i,t}$ or $\Delta\ln Emc_{i,t}$ in both equations.

2.5. Data and Analysis

We use Compustat annual data for North American firms for twenty-seven firm fiscal years from 1989 to 2015. Table 1 provides variable definitions. Table 2 provides descriptive information about the raw data (panel A) and the main variables (panel B) used for analysis in this study - SG&A costs, sales revenue, gross PP&E, number of employees, employment costs, and control variables. In panel A, except for the number of employees, which is in thousands, all reported numbers are in millions of dollars. The information described in panel B is based on the empirical variables, the log of the ratio of the value in period *t* to the value in period *t-1* for the change variables and the actual values for the decrease variables.

[Insert Tables 1 and 2 here]

The descriptive information in panel B and the correlations in panel C provide support for our choice of gross PP&E as a potential driver of SG&A costs. A comparison of the mean and median values for $\Delta\ln SGA$, $\ln\Delta Sales$, and $\Delta\ln PP\&E$ in panel B indicates that the magnitude of change between adjacent periods is similar across these variables. From the DEC and PPE_DEC variables, we see that sales decrease for about 30% of the firm-year observations and gross PP&E decreases for about 20% of the firm-year observations. From the top row of the correlation matrix in panel C, we see that the correlation between $\Delta\ln SGA$ and $\Delta\ln Sales$ is 0.6578 and the correlation between $\Delta\ln SGA$ and $\Delta\ln PP\&E$, is 0.5075. We also note that the correlation between $\Delta\ln SGA$ and change in employee costs, $\Delta\ln Emc$, is 0.6223, consistent with employee costs being a primary component of SG&A.

The samples are drawn from a total population of 325,198 firm-year observations. Following the ABJ study, we exclude observations in which SG&A costs exceed sales, in addition to deleting observations with missing values of SG&A costs, sales, and gross PP&E, resulting in 149,785 observations. We then trim 0.5% from each tail for the dependent variables (the log-change in SG&A costs, number of employees, and employee costs) and for the explanatory variables (the log-change in sales and gross PP&E). Thus, the estimates for the SG&A model that are presented in table 3 are conducted with 124,374 firm-year observations when control variables are not included. However, deleting missing control variables reduces the sample size for estimating models with control variables to 112,736 firm-year observations. A correlation matrix is provided in panel C of table 2.

Most of the research following ABJ has investigated behavior of SG&A costs under the premise that sales activity is a key driver of such costs. Hence, we first estimate our models with change in SG&A costs as the dependent variable. In table 3, panel A, we estimate the basic ABJ model (1a) and find similar results to those originally reported by ABJ. When we add the second cost driver in model (1c), we find that SG&A costs do separate between the two cost drivers and we see that the explanatory power of model (1c) is significantly greater than the explanatory power of model (1a) – see panel C for comparisons of explanatory power. Comparing the coefficients on the sales decrease and PP&E decrease terms with the coefficients on the sales increase and PP&E increase terms respectively, we observe that cost stickiness is less pronounced and that cost inertia is relatively strong in this specification.[11]

[Insert Table 3 here]

In panel B of table 3, we present the results for the single-driver BBCM model (2a) with changes in SG&A costs as the dependent variable. We find evidence of stickiness in periods following sales increases and anti-stickiness in periods following sales decreases, consistent with BBCM. This stickiness and anti-stickiness is also present in the two-driver model (2b). With respect to changes in PP&E, we find cost inertia under both the more optimistic (sales increased in the prior period) and less optimistic (sales decreased in the prior period) circumstances. In untabulated estimations, we include control variables in the BBCM model and find that the results are qualitatively similar.

In panel C of table 3 we compare the explanatory power of our model that includes both a capacity driver and a volume-related driver, with the corresponding single-driver model that only includes a volume-related driver. We consider the base models that do not include controls, the models with control variables, and the BBCM model. In each case, we conduct a likelihood-ratio test under the null hypothesis that the R^2 of the single driver model and the corresponding two-

[11] We conduct our analysis using pooled OLS with two-way clustering by industry and year (Petersen 2009). The results are consistent with the use of one-way clustering by firm combined with year fixed effects.

driver model are equal. In all three cases, we find that our two-driver model provides significantly greater explanatory power than the corresponding single driver model.

Thus, the SG&A results support *H1* that the specification of the asymmetric cost behavior model is improved with additional cost drivers and *H2* that there is cost inertia with respect to changes in capacity.

Cost Stickiness and Cost Inertia with Labor Resources

Selling, general, and administrative (SG&A) costs consist of costs associated with many different resources, including labor costs, other marketing and administrative expenditures, research and development costs not separately disclosed, etc. To draw further insights from the proposed two-driver model, we focus in this section on the behavior of labor resources by considering employee headcount and employee costs as the cost objects of interest. This focus on a specific type of resource allows an exploration of the separation that occurs due to the addition of a second cost driver, enabling a qualitative as well as quantitative comparison between cost stickiness and cost inertia not achievable with a heterogeneous cost pool such as SG&A costs.

Separation of changes in labor resources across our two cost drivers is consistent with two distinct types of labor resources – one associated with the volume of production or sales, and the other associated with capacity. This separation is likely given that utilization of some types of labor resources varies with volume and other types of labor resources are linked to assets, products, and markets. For instance, direct labor costs at a manufacturing plant would be primarily volume-driven, rather than related to physical capacity. While closing the plant would remove the direct labor costs, the removal occurs due to the reduction in sales associated with closing the plant. Some plant overhead costs, such as the plant manager's salary, on the other hand are not volume-driven.

Similarly, for a product line, many of the costs associated with turnover of the product are volume-related but other costs such as compensation of designers and managers of the product line are not volume-driven.

It is useful to consider adjustment costs associated with downturns to compare these two types of labor resources. Adjustment costs related to laying off workers include the human capital embedded in these workers that may be lost when the workers are terminated. Human (or organizational) capital refers to education, knowledge and skills that reside with employees (Milgrom and Roberts 1992; Hatch and Dyer 2004). Human capital is considered to be a critical resource for firms (Pfeffer 1994). While some human capital may be "generic" such as general education, other human capital is firm-specific (Hitt, et al. 2001). Loss of generic human capital that can be easily replaced when demand picks up in the future would not constitute an adjustment cost. But loss of firm-specific human capital that is difficult to buy "off the shelf" is an important adjustment cost because its value only resides with the employee within the firm itself (Milgrom and Roberts 1992; Hatch and Dyer 2004).

We observed earlier that companies have a variety of ways they can adjust employee resources for fluctuations in demand that affect the volume of sales – hiring and firing part-time or temporary workers, utilizing overtime and bonus payments to existing employees, and so forth. We expect that employees who are likely to be added or subtracted with normal fluctuations in the volume of sales would not have high levels of firm-specific human capital. In contrast, employees who are associated with physical capacity are more likely to be longer-serving employees that attain higher levels of firm-specific knowledge and become part of the fabric that makes up the organizational capital. For example, a store associate at Target would be almost as useful at a Walmart store. However, a store manager at the Target store has an understanding of Target-specific systems such as logistics and marketing strategy. Replacement of the manager with a manager from Wal-Mart would result in a loss of this firm-specific knowledge.

Dierynck, Landsman, and Renders (2012) look at differences in cost asymmetry between blue-collar and white-collar employees, and argue that differences in severance costs between blue-collar and white-collar employees cause differences in the asymmetric behavior of their costs. Blue-collar workers receive shorter notices of termination compared to white-collar workers, and redundancy payments are lower when dismissing blue-collar workers compared to white-collar workers. These observed practices may have evolved based on differences in firm-specific human capital between blue-collar and white-collar workers.

Based on this discussion, we expect to find relatively high cost inertia for employee numbers and associated costs driven by PP&E and relatively low cost stickiness for employee numbers and costs driven by sales volume. In table 4, we provide results of estimating the ACB models with the number of employees (employee headcount) as the cost object of interest. We note that employee headcount is an equally-weighted value for employees in that each employee is counted once. However, employee cost is value-weighted in that each employee is weighted based on individual pay. So changes in lower-paid employees would have a greater impact on employee headcount than on employee cost.

[Insert Table 4 here]

The results of estimating model (1a) that is analogous to the basic ABJ model indicate that employee headcount is not sticky (coefficient on sticky costs term = -0.0162, t-statistic = -0.55). This is similar to a finding in Anderson and Lanen (2009) with regard to employee headcount. The results of estimating model (1c) indicate that changes in employee headcount separate between the two cost drivers. Coefficients on both the sales change and PP&E change terms are significantly different from zero and the explanatory power of the model increases significantly (panel C), consistent with hypothesis 1. These results also indicate that employee headcount is anti-sticky with respect to sales (coefficient on the sticky costs term = 0.1350, t-statistic = 5.11). Because headcount may include temporary and part-time employees, this anti-stickiness may reflect aggressive cuts to short-term employees in sales-down periods. On the other hand, the estimated coefficient on the cost inertia term is significantly negative (coefficient = -0.1654, t-statistic = -11.18), consistent with our prediction that cost inertia is relatively strong and cost stickiness is relatively weak with respect to employee headcount.

The results of estimating the BBCM model presented in table 4, panel B provide additional insights. The results of estimating the single-driver model (2a) indicate stickiness in headcount for periods following a revenue increase (coefficient = -0.1944, t-statistic = -2.57) but anti-stickiness for periods following a revenue decrease (coefficient = 0.2104, t-statistic = 8.09). This is consistent with the original BBCM analysis and suggests that estimation of the ABJ model (1a) may mask stickiness in the number of employees because it does not consider the role of managerial optimism. When we add the second driver in model (2b), we again find a separation between sales as a volume of activity driver and PP&E as a driver representing physical capacity managed and markets served. Here we find anti-stickiness with respect to sales in both periods following a revenue increase and periods following a revenue decrease, but we find cost inertia with respect to changes in PP&E in both the more optimistic and more pessimistic settings. Again, as shown in panel C of table 4, the explanatory power of the two-driver model is significantly higher than the explanatory power of the single-driver model. Overall, the results with respect to employee headcount provide additional support for a two-driver ACB model, consistent with our predictions about different adjustment costs for labor pools separately identified by volume of activity and capacity managed.

[Insert Table 5 here]

We move next to an analysis of employee costs. This analysis is based on companies that disclose employee costs separately (less than 10% of companies in our data).[12] Nevertheless, it provides additional insights. Because the sample is so much smaller than the sample that we used for our headcount analysis, we replicated the headcount analysis for the smaller sample (not tabulated). All of the findings described above for our full-data analysis were obtained with the smaller data set. Table 5 presents the results of estimating the models when employee cost is the cost object of interest. In panel A of table 5, using model (1a), we do find stickiness with respect to employee costs that was absent with employee headcount. As noted above, employee costs is a value-weighted measure of labor resource costs so higher paid employees would have greater weight. Thus, a plausible explanation for a finding of cost stickiness with employee costs but not headcount is that companies are more likely to retain more expensive employees in sales-down periods. For instance, talented sales people who have cultivated relationships with key customers would likely be retained.

When we look at the results from estimating the two-driver model (1c), we see that employee costs are weakly sticky (coefficient = -0.0728, t-statistic = -1.35) but there is significant cost inertia (coefficient = -0.0903, t-statistic = -2.91). We find that employee costs separate nicely between the two drivers and the explanatory power of model (1c) is significantly higher than the explanatory power of model (1a), consistent with hypothesis 1. We also find that inertia is relatively strong, consistent with hypothesis 2, and that cost stickiness is relatively weak in the two-driver estimation of equation (1c).

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[12] A potential concern with only including firms that disclose employee costs is that we do not explicitly model for the self-selection of firms reporting employee costs.

For the models that condition on previous period sales (panel B of table 5), in the single-driver model (2a) we find stickiness in periods following a sales increase and anti-stickiness in periods following a sales decrease. In the two-driver model (2b), we also find stickiness in the more optimistic setting and no stickiness in the less optimistic setting. We find inertia in the more optimistic setting and no inertia in the less optimistic setting. Finally, in panel C of table 5, we find that the explanatory power of our two-driver model is significantly greater than the explanatory power of the single driver model. Taken together, our findings with respect to employee costs also support the use of two drivers.

2.6. Robustness Tests

As noted earlier, Balakrishnan, Labro, and Soderstrom (2014) observe that long-term investment decisions could impact the ability of researchers to detect short-term cost management decisions using asymmetric cost behavior models. Balakrishnan et al. (2014) suggest using an alternative percentage changes specification to address this issue. We estimated models (1a) through (1d) using percentage changes specifications (not tabulated) and found that the results of our tests were similar in all material respects to the results obtained using the log-log specifications. We also followed the suggestion by Balakrishnan et al. (2014) to scale the dependent variable by lagged sales instead of its lagged cost value and again found that the results of our tests were substantively similar to those obtained using the log-log specification.

Shust and Weiss (2014) consider the impact of depreciation on cost stickiness. They find that operating expenses after depreciation are significantly stickier than operating expenses before depreciation. In the same spirit, cost inertia may also be biased if depreciation is asymmetrically related to increases and decreases in gross PP&E. Hence, as a robustness check, we estimated our model using changes in operating expenses before depreciation in place of changes in SG&A as our dependent variable. Similar to Shust and Weiss (2014), we found that cost stickiness is significantly lower when operating expenses before depreciation is used as the dependent variable. However, our findings for cost inertia remain robust in this alternative specification.

In our sample construction, we follow much of the literature on sticky costs (e.g., ABJ; Dierynck et al. 2012; Chen et al. 2012; Balakrishnan et al. 2014) and trim both dependent and independent variables to reduce the effect of outliers on our results. However, our results are similar to those reported when we (1) do not trim any of the variables, and when we (2) trim only the independent variables.

2.7. Conclusion

The sticky costs literature has provided new insights about how costs behave in response to sales changes between periods. Analysis of cost behavior over time is relevant for both managerial and financial accounting research. Earnings changes, for instance, are fundamentally linked to cost behavior. Studying how costs change across periods with respect to sales changes is incomplete if resource adjustments depend on other factors or cost-drivers. In this study, we consider an additional capacity cost-driver because long-term capital investments change over time. Our results strongly support the use of gross PP&E as an additional cost driver. We introduce the term “cost inertia” to reflect the downside asymmetry that occurs with respect to changes in physical capacity. We find that cost inertia is particularly strong with respect to adjustment of employee resources. This inertia may be partially due to higher firm-specific human capital associated with labor that is tied to long-term capacity. Inertia with respect to changes in physical capital suggests that managers may plan to redeploy resources that are retained when physical capital is reduced, possibly to accommodate new expansion.

TABLE 2. 1 - Variable Definitions

Variable	Definition
$\Delta\ln SALES_{i,t}$	log-change in sales revenue of firm *i* in year *t* relative to year *t*-1.
$\Delta\ln PP\&E_{i,t}$	log-change in gross property, plant, and equipment (PP&E) of firm *i* in year *t* relative to year *t*-1.
$\Delta\ln Emp_{i,t}$	log-change in number of employees of firm *i* in year *t* relative to year *t*-1.
$\Delta\ln Emc_{i,t}$	log-change in employee costs of firm *i* in year *t* relative to year *t*-1.
$\Delta\ln SGA_{i,t}$	log-change in selling, general, and administrative (SG&A) costs of firm *i* in year t relative to year *t*-1.
DEC	equals 1 if sales revenue of firm *i* decreased between year *t* and year *t*-1, 0 otherwise.
PPE_DEC	equals 1 if gross PP&E of firm *i* decreased between year *t* and year *t*-1, 0 otherwise.
$I_{i,t-1}$	equals 1 if prior year's sales revenue of firm *i* increased, 0 otherwise.
$D_{i,t-1}$	equals 1 if prior year's sales revenue of firm *i* decreased, 0 otherwise.
Succ_DEC	equals 1 if sales revenue of firm *i* in year *t*-1 is less than sales revenue in year *t*-2, 0 otherwise.
lnAsset_Int	log ratio of total assets to sales revenue at time *t.*
lnEmp_Int	log ratio of number of employee to sales revenue at time *t.*
FCF	free cash flow, cash flow from operating activities less common and preferred dividends, and scaled by total assets.

TABLE 2. 2 – Descriptive Statistics

Panel A: Data Description	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile
SG&A (millions)	$330.54	$1,280.61	$36.33	$9.63	$149.24
Sales Revenue (millions)	$1,756.04	$6,523.90	$185.19	$42.12	$838.89
Gross PP&E (millions)	$1,228.38	$5,092.00	$75.79	$13.05	$440.90
Employees (thousands)	7.74	26.02	1	0.22	4.48
Employment Cost (millions)	$834.84	$2,148.07	$96.44	$11.78	$592.00

Panel B: Distribution of Variables (as used in regressions)	N	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile
$\Delta\ln SGA$	124,374	0.1047	0.2670	0.0794	-0.0224	0.2079
$\Delta\ln SALES$	124,374	0.1081	0.2889	0.0818	-0.0259	0.2207
$\Delta\ln PP\&E$	124,374	0.1265	0.2893	0.0807	0.0154	0.2007
$\Delta\ln Emp$	109,099	0.0494	0.2582	0.0263	-0.0531	0.1369
$\Delta\ln Emc$	10,516	0.0975	0.2604	0.0672	-0.0144	0.1812
DEC	124,374	0.2982	0.4575	0	0	1
PPE_DEC	124,374	0.1943	0.3956	0	0	0
Succ_DEC	124,374	0.2568	0.4368	0	0	1
$\ln Asset\_Int$	124,374	0.0294	0.7216	-0.0454	-0.4575	0.4442
$\ln Emp\_Int$	114,445	-5.3151	0.8804	-5.2513	-5.7867	-4.7762
FCF	121,417	186.18	671.07	11.36	0.46	77.39

TABLE 2. 2 – continued

Panel C: Pearson Correlations (p-values reported below correlations)

	$\Delta \ln SGA$	$\Delta \ln SALES$	$\Delta \ln PP\&E$	$\Delta \ln Emp$	$\Delta \ln Emc$	ln*Asset_Int*	ln*Emp_Int*	FCF
$\ln \Delta SGA$	1.0000							
$\ln \Delta SALES$	0.6578 <.0001	1.0000						
$\ln \Delta PP\&E$	0.5075 <.0001	0.4998 <.0001	1.0000					
$\ln \Delta Emp$	0.5046 <.0001	0.5519 <.0001	0.5302 <.0001	1.0000				
$\ln \Delta Emc$	0.6223 <.0001	0.6263 <.0001	0.4470 <.0001	0.4576 <.0001	1.0000			
$\ln Asset\_Int$	0.0829 <.0001	0.0536 <.0001	0.1137 <.0001	0.0937 <.0001	0.0506 <.0001	1.0000		
$\ln Emp\_Int$	-0.0108 0.0002	-0.0566 <.0001	0.0060 0.0426	0.0628 <.0001	0.0183 0.0715	-0.1265 <.0001	1.0000	
FCF	-0.0218 <.0001	-0.0165 <.0001	-0.0335 <.0001	-0.0085 0.0055	-0.0569 <.0001	0.0904 <.0001	-0.1794 <.0001	1.0000

TABLE 2. 3 – Modeling Estimation using Change in SG&A Costs as Dependent Variable

Panel A: Comparisons using ABJ Model

		ABJ Single-Driver Model		Two-Driver Model	
		Base Model (1a)	With Controls (1b)	Base Model (1c)	With Controls (1d)
	Predicted Sign	Coefficient (t-stat)	Coefficient (t-stat)	Coefficient (t-stat)	Coefficient (t-stat)
Intercept		0.0208***	0.0209***	0.0046	0.0046
		(5.30)	(5.79)	(1.33)	(1.46)
$\Delta\ln SALES$	+	0.6729***	0.6847***	0.5186***	0.5302***
		(19.67)	(21.99)	(16.25)	(19.13)
$DEC * \Delta\ln SALES$	-	-0.2151***	-0.1535*	-0.0914***	-0.0326
		(-9.14)	(-1.80)	(-4.62)	(-0.40)
$\Delta\ln PP\&E$	+			0.2657***	0.2638***
				(24.91)	(23.53)
$PPE\_DEC * \Delta\ln PP\&E$	-			-0.1647***	-0.1760***
				(-14.70)	(-13.08)
$DEC * \Delta\ln SALES * Succ\_DEC$	+		0.2657***		0.2324***
			(13.50)		(12.67)
$DEC * \Delta\ln SALES * \ln Asset\_Int$	-		-0.1534***		-0.1301***
			(-11.84)		(-10.76)
$DEC * \Delta\ln SALES * \ln Emp\_Int$	-		0.0268**		0.0238**
			(2.37)		(2.13)
$DEC * \Delta\ln SALES * FCF$	-		0.0001***		0.0001***
			(2.64)		(2.69)
N		124,374	112,736	124,374	112,736
Adjusted R^2		0.4388	0.4648	0.4820	0.5063

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

TABLE 2. 3 – continued

Panel B: Comparisons using BBCM Model

		Predicted Sign	BBCM Model (2a) Coefficient	BBCM Model (2a) (t-stat)	Two-Driver Model (2b) Coefficient	Two-Driver Model (2b) (t-stat)
	Intercept		0.0216***	(5.56)	0.0065**	(1.96)
I	$\Delta\ln SALES$	+	0.7171***	(20.87)	0.5558***	(16.48)
	$DEC * \Delta\ln SALES$	-	-0.3699***	(-14.05)	-0.2215***	(-9.55)
D	$\Delta\ln SALES$	+	0.4284***	(16.87)	0.3775***	(15.61)
	$DEC * \Delta\ln SALES$	+	0.1935***	(9.48)	0.1909***	(10.39)
I	$\Delta\ln PP\&E$	+			0.2514***	(22.89)
	$PPE\_DEC * \Delta\ln PP\&E$	-			-0.1599***	(-11.76)
D	$\Delta\ln PP\&E$	+			0.2117***	(16.59)
	$PPE\_DEC * \Delta\ln PP\&E$	?			-0.1151***	(-7.44)
N			124,374		124,374	
Adjusted R^2			0.4556		0.4913	

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

Panel C: Comparison of Explanatory Power between Single Driver Model and Two Driver Model

	Base Models		Models with Controls		BBCM Model	
	ABJ	Two-Driver	ABJ	Two-Driver	Single Driver	Two-Driver
N	124,374	124,374	112,736	112,736	124,374	124,374
Adjusted R^2	0.4388	0.4820	0.4648	0.5063	0.4556	0.4913
LR Test χ^2 [a]	9,975.36		9,117.50		8,440.29	
(p-value)	($p < 0.001$)		($p < 0.001$)		($p < 0.001$)	

[a] Likelihood-ratio (LR) test of null hypothesis that the R^2s of the single driver model and corresponding two-driver model are equal.

TABLE 2. 4 – Modeling Estimation using Change in Number of Employees as Dependent Variable

Panel A: Comparisons using ABJ Model

		ABJ Single-Driver Model		Two-Driver Model	
		Base Model (1a)	With Controls (1b)	Base Model (1c)	With Controls (1d)
	Predicted Sign	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)
Intercept		-0.0025	-0.0002	-0.0237***	-0.0219***
		(-0.76)	(-0.06)	(-8.07)	(-7.36)
$\Delta \ln SALES$	+	0.5251***	0.5204***	0.3076***	0.3064***
		(17.93)	(17.28)	(13.36)	(13.06)
$DEC * \Delta \ln SALES$	-	-0.0162	0.0065	0.1350***	0.1714***
		(-0.55)	(0.16)	(5.11)	(4.81)
$\Delta \ln PP\&E$	+			0.3811***	0.3772***
				(33.93)	(33.31)
$PPE\_DEC * \Delta \ln PP\&E$	-			-0.1654***	-0.1707***
				(-11.18)	(-10.94)
$DEC * \Delta \ln SALES * Succ\_DEC$	+		0.0866***		0.0314
			(4.00)		(1.39)
$DEC * \Delta \ln SALES * \ln Asset\_Int$	-		-0.1941***		-0.1543***
			(-14.38)		(-12.99)
$DEC * \Delta \ln SALES * \ln Emp\_Int$	-		2.97E-06		-0.0000
			(0.17)		(-1.41)
N		109,099	107,688	109,099	107,688
Adjusted R^2		0.3046	0.3132	0.3979	0.4031

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

TABLE 2. 4 - continued

Panel B: Comparisons using BBCM Model

		Predicted Sign	BBCM Model (2a) Coefficient	(*t*-stat)	Two Driver Model (2b) Coefficient	(*t*-stat)
	Intercept		-0.0022	(-0.69)	-0.0232***	(-7.89)
I	$\Delta\ln SALES$	+	0.5596***	(19.64)	0.3203***	(13.77)
	$DEC * \Delta\ln SALES$	-	-0.1944**	(-2.57)	0.1005***	(3.25)
D	$\Delta\ln SALES$	+	0.3589***	(13.10)	0.2659***	(11.23)
	$DEC * \Delta\ln SALES$	+	0.2104***	(8.09)	0.2094***	(8.20)
I	$\Delta\ln PP\&E$	+			0.3754***	(34.33)
	$PPE\_DEC * \Delta\ln PP\&E$	-			-0.1487***	(-8.48)
D	$\Delta\ln PP\&E$	+			0.3704***	(15.22)
	$PPE\_DEC * \Delta\ln PP\&E$	?			-0.1711***	(-5.94)
N			109,099		109,099	
Adjusted R^2			0.3110		0.3985	

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

Panel C: Comparison of Explanatory Power between Single Driver Model and Two Driver Model

	Base Models		Models with Controls		BBCM Model	
	ABJ	Two-Driver	ABJ	Two-Driver	Single Driver	Two-Driver
N	109,099	109,099	107,688	107,688	109,099	109,099
Adjusted R^2	0.3046	0.3979	0.3132	0.4031	0.3110	0.3985
LR Test χ^2 [a]	15,720.46		15,119.08		14,806.94	
(*p*-value)	(*p* < 0.001)		(*p* < 0.001)		(*p* < 0.001)	

[a] Likelihood-ratio (LR) test of null hypothesis that the R^2s of the single driver model and corresponding two-driver model are equal.

TABLE 2. 5 – Model Estimation using Change in Employee Costs as Dependent Variable

Panel A: Comparisons using ABJ Model

		ABJ Single-Driver Model		Two-Driver Model	
		Base Model (1a)	With Controls (1b)	Base Model (1c)	With Controls (1d)
	Predicted Sign	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)
Intercept		0.0239***	0.0247***	0.0126***	0.0144***
		(4.99)	(5.38)	(3.08)	(3.54)
$\Delta\ln SALES$	+	0.6832***	0.6893***	0.5645***	0.5721***
		(17.86)	(18.09)	(16.35)	(16.81)
$DEC * \Delta\ln SALES$	-	-0.1553***	0.3187	-0.0728	0.4081*
		(-2.87)	(1.41)	(-1.35)	(1.90)
$\Delta\ln PP\&E$	+			0.2154***	0.2072***
				(13.18)	(12.33)
$PPE\_DEC * \Delta\ln PP\&E$	-			-0.0903***	-0.0835**
				(-2.91)	(-2.43)
$DEC * \Delta\ln SALES * Succ\_DEC$	+		0.2657***		0.2502***
			(7.15)		(6.85)
$DEC * \Delta\ln SALES * \ln Asset\_Int$	-		-0.0909**		-0.0641
			(-2.03)		(-1.37)
$DEC * \Delta\ln SALES * \ln Emp\_Int$	-		0.1005**		0.1011**
			(2.28)		(2.45)
$DEC * \Delta\ln SALES * FCF$	-		0.0001**		0.0001**
			(2.08)		(2.03)
N		10,516	9,334	10,516	9,334
Adjusted R^2		0.3948	0.4300	0.4219	0.4551

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

TABLE 2. 5 - continued

Panel B: Comparisons using BBCM Model

		Predicted Sign	BBCM Model (2a) Coefficient	BBCM Model (2a) (*t*-stat)	Two Driver Model (2b) Coefficient	Two Driver Model (2b) (*t*-stat)
	Intercept		0.0249***	(5.18)	0.0145***	(3.55)
I	$\Delta\ln SALES$	+	0.7158***	(17.68)	0.5819***	(13.38)
	$DEC * \Delta\ln SALES$	-	-0.3104***	(-5.07)	-0.1861***	(-3.10)
D	$\Delta\ln SALES$	+	0.4574***	(10.59)	0.4578***	(8.60)
	$DEC * \Delta\ln SALES$	+	0.2478***	(4.15)	0.1585**	(2.14)
I	$\Delta\ln PP\&E$	+			0.2199***	(9.21)
	$PPE\_DEC * \Delta\ln PP\&E$	-			-0.1343***	(-3.14)
D	$\Delta\ln PP\&E$	+			0.0817	(1.48)
	$PPE\_DEC * \Delta\ln PP\&E$	?			0.1004	(1.40)
N			10,516		10,516	
Adjusted R^2			0.4064		0.4311	

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

Panel C: Comparison of Explanatory Power between Single Driver Model and Two Driver Model

	Base Models		Models with Controls		BBCM Model	
	ABJ	Two-Driver	ABJ	Two-Driver	Single Driver	Two-Driver
N	10,516	10,516	9,334	9,334	10,516	10,516
Adjusted R^2	0.3948	0.4219	0.4300	0.4551	0.4064	0.4311
LR Test χ^2 [a]	481.56		420.37		447.22	
(*p*-value)	(*p* < 0.001)		(*p* < 0.001)		(*p* < 0.001)	

[a] Likelihood-ratio (LR) test of null hypothesis that the R^2s of the single driver model and corresponding two-driver model are equal.

Chapter 3. Slack Resources as Real Options

3.1. Abstract

Recent research has examined managers' decisions to retain or release committed resources in response to sales declines. According to theory underlying predictions of asymmetric cost behavior, managers' decisions are based on evaluation of the adjustment costs associated with removing and reacquiring committed resources versus the carrying costs of retaining slack resources, in light of managers' expectations about future demand for those resources. This theory predicts that cost stickiness increases with adjustment costs and managers' optimism about future demand. Implicit in this theory is the notion that slack resources are real options because the expected payoff to retaining committed resources depends on a distribution of future demand under uncertainty. In fact, the option value of slack resources is primary to the analysis of the trade-off between adjustment costs and carrying costs. If the option value does not exceed the carrying value for the horizon period, managers would not retain the slack resources regardless of the level of adjustment costs. In this study, we document that cost stickiness varies systematically across life-cycle stages in a manner that reflects the option value of future revenue changes. We obtain additional insights by investigating how other predictions made in the sticky costs literature depend on firm-life cycle.

3.2. Introduction

We investigate differences in companies' propensity to retain slack resources across life cycle stages by examining asymmetry in cost behavior between sales-up and sales-down periods. We use life-cycle stages to represent circumstances and opportunities that affect the option value of slack resources retained. We validate our use of life-cycle classification in this manner by estimating the option value of one-period ahead revenue changes for firm-years in each life-cycle category. We discriminate between "discretionary" cost stickiness and cost stickiness due to frictions in adjusting firm resources. We find that companies in introductory and growth stages have higher discretionary cost stickiness than companies in mature stages and that companies in decline stages have no discretionary cost stickiness. The pattern of cost asymmetry across life cycle stages is similar to the pattern of option values based on one-year-ahead revenue changes across life-cycle stages, consistent with the interpretation of slack resources as real options.

When demand and sales fall, managers must decide whether to keep or remove committed resources that are no longer required due to the decline in sales activity. Research on asymmetric cost behavior, or sticky costs, has provided insights about managers' decision-making regarding this slack resource management (Anderson, Banker and Janakiraman 2003 (ABJ); Banker and Chen 2006; Weiss 2010; Chen et al. 2012; Kama and Weiss 2013; Banker et al. 2014b (BBCM); Banker and Byzalov 2014a). In addition, many studies on organizational slack have described advantages and disadvantages of holding slack resources (Bourgeois 1981; Yasai-Ardekani 1986; Leibenstein 1969; Nohria and Gulati 1996; Wan and Yiu 2009; Adler et al. 2009; Bradley et al. 2011). From an operational control perspective, managers identify and remove slack resources to avoid inefficiency and mitigate agency problems (Bourgeois 1981; Nohria and Gulati 1996; Leibenstein 1969; Adler et al. 2009). From a forward-looking economic perspective, managers retain slack resources when the expected benefits to be realized from keeping the resources outweigh the costs of carrying those resources (Anderson et al. 2003). Thus, managing slack resources when sales decline is an important and complex task for managers (Bourgeois 1981).

Managers must consider a variety of relevant costs and potential benefits when making resource adjustment decisions. Ease of adjustment is an important consideration. Managers compare the adjustment costs associated with releasing slack resources (and acquiring similar resources after a sales downturn) with the carrying costs of retaining the slack resources through the expected duration of the downturn (ABJ; BBCM; Banker and Byzalov 2014a). Adjustment costs include such things as severance pay when employees are terminated, and search and training costs to bring new employees onboard, or costs incurred to close facilities and subsequently open new facilities. These adjustment costs vary depending on the level of customization of firm resources (Banker, Flasher, and Zhang 2014c). For instance, sales facilities may be designed and fitted to meet firm-specific needs, so costs incurred to customize such facilities cannot be recaptured in the property market. In this case, there would be high adjustment costs for disposing of existing facilities and then acquiring new facilities if demand is restored. Similarly, firms make firm-specific investments in employees that are lost if the employees are terminated.

Another important consideration in evaluating slack resources is demand volatility. Flexible resources can be acquired when firms need those resources but committed resources must be in place to take advantage of increases in demand in the short run (Kaplan and Cooper 1998). Slack in committed resources in low demand periods provides additional capacity so companies can avoid lost sales from congestion in high demand periods (Banker et al. 2013a). Another consideration is the organizational value of slack resources to the firm. Slack resources may play a strategic role when sales decline by facilitating pursuit of alternative projects, process improvement, and new markets (Bradley et al. 2011). Too little slack constrains managers' decision-making (Adler et al. 2009), reducing flexibility and may lead to myopic decision-making as opposed to decisions that are taken from a longer-term perspective.

Although previous studies have brought attention to these ideas, there is a lack of coordinating structure to the analysis of slack resources. A common element that influences decision-making aimed at avoiding adjustment costs, reducing lost sales due to congestion, and limiting lost opportunities from constraints on managers' decision-making, is anticipation of uncertain future demand. In each case, the pay-off from holding slack resources depends on realization of future sales. From this perspective, we provide structure to the analysis by treating slack resources as real options.

The theory underlying research on asymmetric cost behavior predicts that managers compare the adjustment costs associated with removing and replacing committed resources with the carrying costs of retaining slack resources for the anticipated duration of a sales decline (Banker and Byzalov 2014a) Consistent with this theory, empirical research on asymmetric cost behavior has documented that cost stickiness increases with adjustment costs (ABJ and Banker et al. 2013b) and that stickiness is stronger when a sales decline follows a sales increase in the previous period than when sales decrease in two consecutive periods (BBCM). This latter study interprets a second consecutive sales decrease as a proxy for loss of optimism that sales will rebound in the near future. Implicit in the adjustment costs and optimism analysis is the notion that slack resources are real options whose value depends on a distribution of future demand under uncertainty.

By recognizing that slack resources are real options, our work takes a forward-looking approach that considers the option value of slack resources when future demand is stochastic. This means that differences in the value of slack resources are determined by the likelihood that the firm will realize the benefits of retaining slack through increased sales. Increased sales may result from natural fluctuations in demand for the firm's products or from changes in demand generated by firm actions such as development of new or improved products, changes in processes that make the firm more competitive, or expansion to new markets. Importantly, much of the potential value of slack resources is determined by the life-cycle stages of the firm's products.

We interpret the manager's decision to retain slack resources after a decline in sales as an option purchased for the period of the manager's decision horizon. For example, the decision horizon may be a year – managers would then identify slack resources after a sales decline and decide whether to keep or release slack resources for the one-year horizon period. The *cost of the option* is the cost of carrying the slack resources for the duration of the decision horizon. The option value of the slack resources depends on the distribution of future outcomes. If the expected payout or option value of slack resources does not exceed the anticipated carrying costs, the manager would release the slack resources. An important deduction from this analysis is that the option value of slack resources is primary to the consideration of adjustment costs. If the option value does not exceed the carrying value of the slack resources for the length of the decision horizon, then managers would forego retaining the slack resources regardless of the adjustment costs.

We use life-cycle classification to differentiate across firms based on circumstances and opportunities that would affect the option value of slack resources. For this purpose, we employ an innovative method to classify firms according to their life-cycle stages based on underlying product life cycles reflected in cash flow patterns (Dickinson 2011)[13]. To validate the use of this

[13] Detailed description of Dickinson's cashflow based life cycle classification is provided in appendix. .

life-cycle classification in this manner, we estimate the option value of one-year ahead revenue changes by life-cycle category for the firm-year observations in our data. This part of our analysis is described and presented in the appendix.

We discriminate between "discretionary" cost stickiness and cost stickiness due to frictions in adjusting resources. Managers' decisions to release resources may be constrained by frictions in adjusting resources in the short run. For instance, some resources may be tied to asset positions that cannot be unwound easily in the short term. Adjusting human resources may also involve frictions. ABJ recognized these frictions and included asset intensity and employee intensity as variables that may affect cost stickiness across firms. Agency concerns introduce another friction. Previous research indicates that empire-building managers may be reluctant to adjust resource commitments downwards for personal gratification.

We estimate an expanded version of the ABJ model that permits differences in cost stickiness across life-cycle stages. We find that discretionary cost stickiness is similar for firms in introductory and growth stages and that discretionary stickiness for firms in these early stages is greater than for mature firms. We find that firms in decline stages have no discretionary cost stickiness. The pattern of cost stickiness is similar to the pattern of the option values of revenue changes across life-cycle stages. Thus, our evidence supports the treatment of slack resources as real options. We find that frictions related to asset intensity are important in all life-cycle stages but frictions related to employee intensity are conditional on life-cycle stage. For firms in introduction and decline stages, cost stickiness increases with employee intensity. For firms in growth and mature stages, cost stickiness decreases with employee intensity. We also find that cash flows (empire-building) have a significant impact on stickiness for mature stage firms but not for firms in other stages.

In summary, our study presents and validates the treatment of slack resources as real options, providing a structure for decision-making. It links organizational and accounting literature on slack resources and discriminates between "discretionary" cost stickiness and cost stickiness due to frictions in adjusting resources. It provides evidence that managers' appraisal of slack resource value depends on circumstances and opportunities reflected in life-cycle classification. It also documents that constraints that affect cost stickiness vary across life-cycle stages. Finally, we demonstrate the use of margin analysis to measure total cost stickiness.

3.3. Background and Hypotheses

3.3.1. Organizational Slack

Survival in the market against severe competition is characterized as the definitive goal of the firm (Cyert and March 1963; Pfeffer and Salancik 1978; Thompson 1967). To realize this goal, growth of the firm is a necessary condition. The benefits of growth are economies of scale and other economies resulting from creative interaction between the firm's resources and market opportunities (Penrose 1959), enabling firms to gain market share. Growth firms encounter highly dynamic environments characterized by frequent changes and uncertainty, generating more opportunities for value creation (Zahra 1993) as well as greater risk of failure in the market. As a way to counter threats in a dynamic market environment, firms often make strategic decisions to maintain some amount of slack (Bourgeois 1981) and use this slack as a buffer against external shocks (Chopra and Sodhi 2004; Hendricks and Singhal 2005; Azadegan et al. 2013).

Resource slack is defined as resources in excess of those required to carry out firm activities. There have been many discussions about the role of resource slack, including pros and cons (Bourgeois 1981 and Nohria and Gulati 1996). Yasai-Ardekani (1986) contended that too little resource slack causes constraints in decision making while Leibenstein (1969) argued that too much resource slack leads to inefficiencies. Bradley et al. (2011) and Wan and Yiu (2009) documented constructive effects of slack resources by providing evidence that organizational slack enabled firms to react to unexpected disturbances, resulting in continuity of business. On the other hand, Adler et al. (2009) showed that excessive resource slack could limit competitiveness through resource inefficiency.

These competing arguments between positive and negative effects of resource slack also appear in the strategy and finance literatures, especially with respect to the relationship between resource slack and firm performance. One stream of research asserts that slack negatively affects firm performance by causing strategic and structural mismatches that increase inefficiency (Brush et al. 2000; Jensen and Meckling 1976; Leibenstein 1969; Litschert and Bonham 1978; Yasai-Ardekani 1986). Another perspective describes positive effects of resource slack on firm performance through intra-organizational cooperation, increased experimentation, and buffering from external shocks (Bourgeois 1981; Cyert and March 1963; Meyer 1982). A recent study by Bradley et al. (2011) highlighted positive effects by observing that slack resources enable firms to have discretionary margin for pursuing new projects, improving processes, and exploring new markets. The roles and effects of slack resources remain subjects to be investigated in more depth while there is consensus that the advantages and disadvantages of organizational slack depend on firm circumstances and opportunities.

3.3.2. Cost Asymmetry

Research on cost behavior predicts that costs respond asymmetrically to increases and decreases in sales, and attributes this asymmetry to deliberate resource commitment decisions by managers (Cooper and Kaplan 1992; Noreen and Soderstrom 1994). Anderson et al. (ABJ) (2003) document that the percentage increase in selling, general and administrative (SG&A) costs for increases in sales is larger than the percentage decrease in SG&A costs for equivalent decreases in sales. Using a pooled sample of Compustat firms ranging from 1979 to 1998, they found that SG&A costs on average increased 0.55% with a 1% increase of sales revenue but only fell 0.35% with a 1% decrease of sales revenue.

Subsequent studies about cost stickiness have focused on determinants of firms' asymmetric cost behavior. Balakrishnan et al. (2004) found that current capacity utilization plays a pivotal role in determining the extent of cost stickiness for physical therapy clinics. Balakrishnan and Gruca (2008) compared core patient care activities with the activities of supporting departments in hospitals and found that cost stickiness for core patient care is higher than that for supporting departments.

Dierynck et al. (2012) found that managers meeting or beating the zero earnings benchmark increase labor costs to a smaller extent when activity increases and decrease labor costs to a larger extent when activity decreases. Chen, Lu, and Sougiannis (2012) found that cost stickiness increases with managers' empire-building incentives and opportunities measured by free cash flows (FCF), CEO horizon, tenure, and compensation structure. These findings are meaningful in demonstrating that the stickiness of SG&A costs is affected by agency factors in addition to other economic factors.

Banker et al. (BBCM) (2014b) investigated how the pattern of sales changes moderates the asymmetric behavior of costs. They conditioned the current response of SG&A costs to sales on the direction of the sales change in the previous year and found stickiness when sales increased in the previous period and anti-stickiness when sales decreased in the previous period. This pattern is consistent with managers holding slack resources when they are more optimistic about future sales and releasing slack when their optimism fades.

In addition to these studies, market-based research finds that capital market participants do not fully appreciate the value implications of asymmetric cost behavior (Banker and Chen 2006; Anderson et al. 2007). Kama and Weiss (2013) explored motivations underlying managerial resource adjustments with respect to sticky costs. The focus of their study was on the impact of incentives to meet earnings targets on resource adjustments and the ensuing cost structures. With regard to managers' consideration of adjustment costs when changing resource levels, Banker, Byzalov, and Chen (2013b) tested the impact of employment protection legislation (EPL) provisions on labor adjustment costs using data from nineteen OECD (Organization for Economic Co-operation and Development) countries. They found that the degree of cost stickiness increases with the strictness of the country-level EPL provisions. A series of recent studies (Chen, Gores, and Nasev 2015; Qin, Mohan, and Kuang 2015; Yang 2015) shows how managers' overconfidence and hubris have an influence on their resource commitment decisions.

Banker and Byzalov (2014a) synthesized the theory and literature on asymmetric cost behavior. They regard adjustment costs and managers' optimism as the economic primitives underlying asymmetric cost behavior. From this perspective, managers' decisions about adjusting resource levels are discretionary and deliberate, and the interaction of managerial discretion and resource adjustment costs creates dynamics in the determination of resource levels. A number of empirical studies testing for sticky costs (Anderson et al. 2003; Banker et al. 2014b; Weiss 2010; Chen et al. 2012; Kama and Weiss 2013) consistently find such asymmetry in costs. Following the in-depth review and discussion of the economic theory of asymmetric cost behavior by Banker and Byzalov (2014a), Noreen (2016) provides an analytical model of cost asymmetry.

Balakrishnan et al. (2014) critique the empirical model described in Anderson et al. (2003) and propose alternative specifications.[14]

We combine the organizational perspective provided by the organizational slack literature with the economic perspective of the asymmetric cost behavior literature. Accordingly, we consider how managers' evaluation of slack resources represented by cost asymmetry differs across circumstances and opportunities represented by firm life-cycle.

3.3.3. Real Options

Firms recognizing a lack of information and uncertainty regarding future markets update their business strategies to limit costs and disaggregate risks (Folta 1998). While uncertainty increases risk, it also provides firms with opportunities to generate new value (Myers 1977). Real options provide a way to address risk and uncertainty in management (Kogut 1991) by giving managers the rights but not the obligations to undertake certain business initiatives, thereby giving firms the ability to profit from uncertainty (Amram and Kulatikala 1999). Like a financial option, the value of a real option depends on the likelihood that states of nature under which the option would pay off will be realized (Cohen and Huchzermeier 1999). In fact, the value of a real option is derived in a similar manner to the value of a financial option.

Unlike the traditional view where uncertainty discourages managers from making investments, real option theory provides a reason to be more proactive in responding to uncertainty. With real options, firms are able to delay investment commitments, stage them, or alter future decisions when the market changes, containing losses and realizing benefits from uncertainty

[14] We estimate models separately using two specifications recommended by Balakrishnan et al. (2014), a percentage change specification and a specification that deflates both the change in SG&A costs and the change in sales by previous period sales. Results of estimating these alternative specifications are quantitatively and qualitatively similar to the results we obtain using the Anderson et al. (2003) specification.

under more favorable business circumstances (Bowman and Hurry 1993; McGrach 1997; Trigeorgis 1996; Trigeorgis et al. 2017). Cohen and Huchzermeier (1999) argued that managers could limit loss and damage from uncertainty related to the level of product demand by using real options. Studies document a variety of types of real options (Trigeorgis 1996; Seppä 2000): (1) Defer - enabling management to defer investment and benefit from more information (Ingersoll and Ross 1992; Trigeorgis 1996; Benaroch and Kauffman 2000), (2) Time or stage – when an investment is seen as a series of outlays, this option provides an opportunity to abandon the project in the middle if new information is unfavorable (Brennan and Swartz 1985; Trigeorgis and Mason 1987; Pindyck 1988), (3) Lease – lease or rent a property with an option to buy it at some time in the future (Clemons and Weber 1990), and (4) Outsource – release the resources required for investment realization to external parties (Richmond and Seidmann 1993). In sum, the value of real options does not come from volatility alone but from strategic business management.

Real options are often described with regard to capital investments (Dixit and Pindyck 1995) but the same logic may be applied to cash flow opportunities made available through holding slack resources. By retaining slack resources, a company may be better positioned than its competitors to take advantage of market opportunities and avoid congestion that occurs when companies compete for limited or scarce resources. Holding slack resources is costly but managers have the right to remove the slack resources if they do not believe that the expected pay-offs exceed the costs of holding the slack resources.

3.3.4. Firm Life Cycle

The Boston Consulting Group (BCG) suggested a strategic management concept tied to life cycle in 1968. The underlying idea was that growth firms have incentives to increase revenue early in their life cycle by building cost or demand advantages through active investment, but firms at mature or decline levels would decrease such investment due to slower market growth and less reaping from their investment (Porter 1980). In economics, the literature has focused more on product and industry life cycles (Spence 1977, 1979, 1981; Wernerfelt 1985; Jovanovic and MacDonald 1994), including analysis of such things as market entry and exit of firms (Caves 1998), learning and experience (Spence 1981), and investment (Spence 1977, 1979; Jovanovic 1982; Wernerfelt 1985), than on the life cycle of the entity itself. However, from an aggregation of these studies, firm level life-cycle theory has evolved that predicts patterns of sales over the life of the firm, similar to product life cycle theory that predicts certain patterns of sales over product time.

Richardson and Gordon (1980) suggested that the implications of performance measures vary across life-cycle stages of firms. By adopting sales growth, capital expenditure, dividend rate, and firm age as proxies for firm life cycle, Anthony and Ramesh (1992) found that the stock market response to accounting performance measures is conditioned by the life cycle stage of a firm. They found that growing firms show a positive relationship between sales growth and capital investment but this relationship does not hold for mature and decline firms.

Dickinson (2011) explored cash flow patterns as proxies for firm life cycle stages. She observed that life cycle information derived from cash flow patterns would enable information users such as investors, analysts, and auditors to investigate and control for differences in resources, rates of investment, experience curves, and production efficiencies using a parsimonious measure. Dickinson considered firms as aggregations of multiple products in different product life cycle stages and in multiple industries. Dickinson provides evidence that her cash flow patterns outperform other life cycle proxies in explaining future profitability.

Hribar and Yehuda (2015) investigated the implications of life-cycle with respect to the mispricing of free cash flows (FCF) and total accruals (TA) and found that the correlation between

FCF and TA is weakest in the growth stage and becomes stronger as the firm matures. This finding suggests that FCF and TA convey different information at various stages of the firm life cycle: at the growth stage the information conveyed by each of the signals is unique but in the mature and decline stages the degree of common variance between these components is higher.

3.3.5. Hypotheses

Asymmetric cost behavior occurs because managers make deliberate decisions to retain or release committed resources following a decline in sales activity. Previous research on sticky costs has focused on the trade-off between adjustment costs associated with releasing and reacquiring resources and the costs of carrying slack resources through a sales downturn (ABJ; Banker and Byzalov 2014a). Because carrying costs increase with the duration of a downturn, this trade-off depends on whether managers' expectations about future sales for their products are more or less optimistic.

Prior research has used the direction of sales change in the previous period to provide information about managers' optimism or pessimism in the current period (BBCM). To enrich and provide additional structure to this analysis, we adopt a real options approach to the study of resource slack revealed by asymmetric cost behavior. The option value of slack resources depends on the distribution of future revenue changes for the horizon period. If the option value of slack resources exceeds the carrying costs, managers would then compare the adjustment costs with the carrying costs to decide whether to retain the slack resources for the horizon period.

To facilitate analysis of the value of slack resources as real options, we use life-cycle stages to represent diverse firm circumstances and opportunities facing managers when they assess the option value of slack resources. Firm circumstances include availability of cash to fund operations and growth while opportunities are characterized by expectations and uncertainty.

Introduction (intro) stage firms typically face cash constraints, have high expectations and high uncertainty. At this stage, firm size is small and managers lack knowledge of potential revenues and costs (Jovanovic 1982). Their primary concern is to successfully establish themselves in the market (Cyert and March 1963; Pfeffer and Salancik 1978; Thompson 1967). Slack resources are valuable if they enable the company to develop and take advantage of market opportunities.

Growth stage firms have developed a successful business model and seek to expand their markets. Spence (1977) argued that there is strategic interaction among growth stage firms and that investment and growth for such firms are constrained by both physical and financial factors. Growth stage firms make substantial investments in assets and resources to expand their market share ahead of their competitors and to defer entry of other firms (Spence 1977, 1979, 1981). Compared to intro stage firms, growth firms have better access to debt capital (Myers 1977; Barclay and Smith 2005). Based on their successful entry into the market, growth firms have higher expectations and face less uncertainty than intro stage firms. Slack resources are valuable for taking advantage of growth opportunities.

Compared to growth stage firms, mature firms seek efficiency through increased knowledge of operations and markets (Spence 1977, 1979, 1981; Wernerfelt 1985). At this stage, markets are more established and uncertainty is less than for growth stage firms. Resource flexibility becomes more important for adjusting resources to efficient levels when sales increase or decrease. Slack resources are valuable if they reduce congestion when demand increases but there is more pressure to remove slack to obtain higher efficiency and less need to retain slack to take advantage of new market opportunities.

Decline stage firms are losing competitiveness in their markets. Loss of competitiveness brings declining sales and price decreases (Wernerfelt 1985), resulting in liquidation of assets to service debts. At this stage, firms cut underperforming assets and focus on either repayment or renegotiation of debt because preserving cash is closely related to firm survival. Under such circumstances, slack resources have little appeal to managers.

Consistent with our argument that slack resources have real option value, we look at managers' decisions to retain resource slack as a combination of two components - discretionary retention of resource slack tied to the option value and retention of resource slack due to frictions in adjusting resources. To support and validate our analysis of discretionary resource slack based on life-cycle stage, we estimate the option value of one-year ahead revenue changes for the firm-years in our data (see appendix).

The distributions of one-year-ahead revenue changes across life-cycle stages presented in the appendix are consistent with our descriptions above, the mean value and volatility are high for intro stage firms, the mean value is higher and the volatility is somewhat lower for growth stage firms, the mean value is lower and the volatility is substantially lower for mature stage firms, and the mean value is lowest but the volatility is high again for decline stage firms. Based on our evaluation of the option values by life-cycle stage described in the appendix, the estimated option values of one-year ahead revenue changes are similar for intro and growth stage firms, \$3.65 and \$3.76 respectively. For later life-cycle stages, the option values are much lower, \$1.70 for mature stage and \$0.64 for decline stage firms respectively. We base our first hypothesis about the discretionary value of resource slack on the relative differences in the option values of one-period-ahead revenue changes across life-cycle stages.

H1A: Discretionary resource slack, represented by cost stickiness, is *higher* for companies in early life-cycle stages than for companies in the mature life-cycle stage.

H1B: Discretionary resource slack, represented by cost stickiness, is *lower* for companies in the decline life-cycle stage than for companies in the mature life-cycle stage.

Both discretionary retention of slack resources and retention of slack resources due to frictions in adjusting resources lead to cost stickiness. Following ABJ and other studies, we examine how asset intensity and employee intensity affect resource adjustments across life-cycle stages.

Asset intensity is the amount of assets per dollar of sales at a specific level of sales. When sales decline, the company has to adjust its assets downward to retain efficiency. Such adjustment is constrained because physical assets are not easily adjusted in the short run. When asset intensity is higher, this friction is greater. To the extent that changes in SG&A costs depend on asset adjustments, there will be stickiness of SG&A costs.

Firms add or remove assets throughout the various life cycle stages. However, the rationale for adding assets is different for each life cycle stage. Intro and growth stage firms are concentrating on establishing markets. To obtain economies of scale and deter the entry of potential competitors, such firms make large-scale investments in the early stages of their business (Spence 1977, 1979, 1981). Mature stage firms renew old assets to avoid obsolescence and maintain competitiveness (Jovanovic 1982; Wernerfelt 1985). They may also add assets to cultivate new markets and trim assets that are in underperforming markets. Decline firms cut underperforming assets. However, regardless of the firm life-cycle stage, assets are not easy to adjust (high resistance), associated costs include both out-of-pocket costs and management time and effort required to acquire or dispose of assets. We expect that, across firm life cycle stages, retention of slack resources revealed by cost stickiness increases with asset intensity.

H2: Cost stickiness increases with *asset intensity* in all life-cycle stages.

Employees are another source of friction in resource adjustment. Adjustment costs for employees include severance pay and investments in human capital that are lost when employees are terminated, as well as search and training costs for new employees. However, there are important differences between removing assets and terminating employees. Employees are more easily separable – it takes little managerial time to cut employees and employees are not bundled like assets. Adjustment costs for certain types of employees – unskilled labor for instance – are low. Companies may incorporate flexibility in labor by employing part-time or temporary workers and by outsourcing some tasks to external entities. In a sales downturn, companies typically trim discretionary items such as travel and entertainment, reduce capital expenditures, and cut employees before they cut assets.

Employee intensity is the number of employees per dollar of sales at a specific level of sales. When sales decline, the company has to adjust its employees downward to retain efficiency. Because there are adjustment costs associated with reducing the number of employees, there is friction (Banker et al 2013b). A key difference between employee intensity and asset intensity is that employees may be directly a part of SG&A costs. As described above, resource flexibility is more valuable for mature firms than for early stage firms and companies can reduce frictions in adjusting employees in various ways. Therefore, we expect that the effect of employee intensity on cost stickiness will be lower for mature firms than for firms in earlier life-cycle stages. Because firms in the decline stage may already have trimmed their employees to skeleton staff levels, we expect that the effect of employee intensity on cost stickiness will be higher for firms in decline stages than for firms in the mature stage.

> ***H3A***: Cost stickiness increases less with *employee intensity* in the mature life-cycle stage than in earlier life-cycle stages.

> ***H3B****:* Cost stickiness increases more with *employee intensity* in the decline life-cycle stage than in the mature life-cycle stage.

Our treatment of slack resources as real options takes a forward-looking approach that considers the value of slack when future demand is stochastic. According to prior studies, cost stickiness is stronger when a sales decline follows a sales increase in the previous period than when sales decrease in two consecutive periods (BBCM). This literature interprets a second consecutive sales decrease as a proxy for loss of optimism. Under our interpretation of slack resources as real options, a second period of sales decline represents a new horizon period and an increase in the slack resources available. If managers have already retained slack resources from the first decline, they are not likely to add more slack. Empirically, the coefficient on the consecutive sales decline variable must be interpreted together with the coefficient on the base stickiness variable. If no new slack is added, the coefficient on the consecutive sales decline variable would be positive to offset the negative coefficient on the base stickiness term. A second decline may be more impactful for fragile companies in the intro and decline stages.

> ***H4A***: Cost stickiness decreases with a second consecutive sales decline.

> ***H4B***: The reduction in cost stickiness associated with a second consecutive sales decline is higher for firms in intro and decline stages.

Chen et al. (2012) bring corporate governance in as a moderating factor for cost stickiness and provide evidence that cost stickiness increases with managers' empire-building incentives.

Such incentives are likely to be highest in the mature stage when excess cash may be available and managers are less concerned about growth or survival. Therefore, we make the following hypothesis regarding free cash flow.

H5: Cost stickiness is positively associated with a firm's free cash flow (FCF) in the mature stage.

3.4. Data and Empirical Models

We use North American firms' annual Compustat data spanning twenty-five years from 1989 to 2014 in our analysis. Variable definitions are in table 1. Descriptive information about this data is provided in table 2. Table 2 consists of two panels: panel A shows descriptive statistics for the full sample and each life cycle stage and panel B shows the distribution of firms across the five life-cycle categories. In panel A, the number of employees is in thousands and GDP growth is in percentages. All other reported numbers are in millions of dollars. The information described in panel B is based on Dickinson's (2011) life-cycle classification.[15] She depends on cash flow patterns to proxy for firm life-cycle stages. The distribution of the sample across firm life cycle stages is similar to that reported by Dickinson (2011). Growth and mature firms occupy the largest portions and decline firms occupy the smallest portion of the distribution.

[Insert tables 1 and 2 here]

Following both Anderson et al. (2003) and Dickinson (2011), we exclude observations in which SG&A costs exceed sales, in addition to the exclusion of financial firms, resulting in 158,346 observations. Then we trim 0.5% from each tail for the dependent variable (the log-change in SG&A costs) and for the explanatory variables (the log-change in sales, employee intensity, and

[15] Details and empirical validation of Dickinson's life cycle classification is provided in appendix. In addition, a description of opportunities that determine the real option value of slack resources is also included in the appendix.

asset intensity). Estimation for the full sample is based on 86,944 firm-year observations after reductions for missing variables and lagged variables. We adopt the ABJ model (Anderson et al., 2003) for estimating firms' selling, general and administrative (SG&A) cost behavior. The ABJ model uses the ratio and log specification to enhance comparability of the variables and to mitigate potential heteroscedasticity.

To illustrate incorporation of life-cycle classification in the cost behavior models, we estimate the ABJ model including expansion variables (consecutive years' sales decrease, asset intensity, employee intensity, GDP growth, and free cash flow (FCF)) that relates changes in SG&A costs to changes in sales. In equation 1, we permit the intercept term to vary by each life-cycle stage meaning that the same results are obtained when the models are estimated for the full sample with interaction terms for life-cycle stage (table 3) and when the sample is divided into life-cycle stages and the models are estimated separately for each life-cycle stage with equation 2 (table 4).

$$
\begin{aligned}
&\Delta\ln SG\&A_{i,t} = \beta_0 + \beta_1 \Delta\ln SALES_{i,t} + \beta_2 DEC\, \Delta\ln SALES_{i,t} \\
&+\beta_3 DEC\, \Delta\ln SALES_{i,t}\, Succ\_Dec_{i,t} + \beta_4 DEC\, \Delta\ln SALES_{i,t}\, AssInt \\
&+ \beta_5 DEC\, \Delta\ln SALES_{i,t}\, EmpInt + \beta_6 DEC\, \Delta\ln SALES_{i,t} Growth_{i,t} + \beta_7 DEC\, \Delta\ln SALES_{i,t} FCF_{i,t}
\end{aligned}
$$

$$
\begin{aligned}
&+INT\, (\beta_8 + \beta_9 \Delta\ln SALES_{i,t} + \beta_{10} DEC\, \Delta\ln SALES_{i,t} + \beta_{11} DEC\, \Delta\ln SALES_{i,t}\, Succ\_Dec_{i,t} + \\
&\beta_{12} DEC\, \Delta\ln SALES_{i,t}\, AssInt + \beta_{13} DEC\, \Delta\ln SALES_{i,t}\, EmpInt + \\
&\beta_{14} DEC\, \Delta\ln SALES_{i,t} Growth_{i,t} + \beta_{15} DEC\, \Delta\ln SALES_{i,t} FCF_{i,t})
\end{aligned}
$$

$$
\begin{aligned}
&+GRW\, (\beta_{16} + \beta_{17} \Delta\ln SALES_{i,t} + \beta_{18} DEC\, \Delta\ln SALES_{i,t} + \beta_{19} DEC\, \Delta\ln SALES_{i,t}\, Succ\_Dec_{i,t} + \\
&\beta_{20} DEC\, \Delta\ln SALES_{i,t}\, AssInt + \beta_{21} DEC\, \Delta\ln SALES_{i,t}\, EmpInt + \\
&\beta_{22} DEC\, \Delta\ln SALES_{i,t} Growth_{i,t} + \beta_{23} DEC\, \Delta\ln SALES_{i,t} FCF_{i,t})
\end{aligned}
$$

$$
\begin{aligned}
&+DCL\, (\beta_{24} + \beta_{25} \Delta\ln SALES_{i,t} + \beta_{26} DEC\, \Delta\ln SALES_{i,t} + \beta_{27} DEC\, \Delta\ln SALES_{i,t}\, Succ\_Dec_{i,t} + \\
&\beta_{28} DEC\, \Delta\ln SALES_{i,t}\, AssInt + \beta_{29} DEC\, \Delta\ln SALES_{i,t}\, EmpInt + \\
&\beta_{30} DEC\, \Delta\ln SALES_{i,t} Growth_{i,t} + \beta_{31} DEC\, \Delta\ln SALES_{i,t} FCF_{i,t})
\end{aligned}
$$

$$+SHO\ (\beta_{32} + \beta_{33}\ \Delta\ln SALES_{i,t} + \beta_{34}DEC\ \Delta\ln SALES_{i,t} + \beta_{35}DEC\ \Delta\ln SALES_{i,t}\ Succ\_Dec_{i,t} + \beta_{36}DEC\ \Delta\ln SALES_{i,t}\ AssInt + \beta_{37}DEC\ \Delta\ln SALES_{i,t}\ EmpInt + \beta_{38}DEC\ \Delta\ln SALES_{i,t} Growth_{i,t} + \beta_{39}DEC\ \Delta\ln SALES_{i,t} FCF_{i,t}) + \varepsilon_{i,t} \tag{1}$$

$$\Delta\ln SG\&A_{i,t} = \beta_0 + \beta_1\ \Delta\ln SALES_{i,t} + \beta_2\ DEC\ \Delta\ln SALES_{i,t} + \beta_3 DEC\ \Delta\ln SALES_{i,t}\ Succ\_Dec_{i,t} + \beta_4 DEC\ \Delta\ln SALES_{i,t}\ AssInt + \beta_5 DEC\ \Delta\ln SALES_{i,t}\ EmpInt + \beta_6 DEC\ \Delta\ln SALES_{i,t}\ Growth_{i,t} + \beta_7 DEC\ \Delta\ln SALES_{i,t}\ FCF_{i,t} + \varepsilon_{i,t} \tag{2}$$

The dummy variable *DEC* takes a value of 1 when sales decrease between period *t*-1 and period *t*, otherwise 0. Similarly, the dummy variable *Succ_Dec* is activated for firm-year observations when sales decreased during the preceding period. The symbol Δ is used throughout to represent the ratio of the value in the current period (*t*) to the value in the previous period (*t-1*) as opposed to a simple first difference. In addition, a series of notations - INT, GRW, DCL, and SHO – indicates firm life-cycle classification ‘Introduction stage firms’, ‘Growth stage firms’, ‘Decline stage firms’, and ‘Shake-out firms’, respectively. Note that in the equation 1 there is no indicator for ‘Mature stage firms’ because this stage plays the base role in the model. For instance, in table 3, evaluating $\beta_1$and β_1+β_2 enables a comparison between the responsiveness of SG&A costs to sales in sales up and sale down periods for mature firms. On the other hand, to interpret the cost asymmetry between sales up and sales down for introduction stage firms, a comparison between β_1+β_9, which represents sales up periods, and β_1+β_2+β_9+β_{10}, which represents sales down periods, is required.

In their analysis, Anderson et al. (2003) used the log values of asset intensity and employee intensity instead of the simple ratios of total assets to sales and the number of employees to sales. We use the simple ratios in order to interpret the base stickiness terms as discretionary stickiness.

Because the log values for ratios less than one are negative and increase in magnitude as the ratios get smaller, the base stickiness term (discretionary slack) compensates and cannot be meaningfully interpreted as the base value when the log values of asset intensity and employee intensity are low. By using the simple ratios of asset intensity and employee intensity, we avoid this concern and make it possible to interpret the base stickiness term as the stickiness that would be found at low levels of asset and employee intensity.[16]

3.5. Results and Analysis

Tables 3 and 4 provide information about asymmetric cost behavior conditioned on firm life cycle.[17] Table 3 includes estimation of equation 1 for the full sample and table 4 includes estimation of equation 2 for each separate life-cycle. Because the intercept is permitted to vary by life-cycle, the estimations provided in table 4 summarize the estimations of table 3. Our analysis and discussion of results pertain to the four meaningful life-cycle stages – intro, growth, mature, and decline – and not to shake-out firms. As indicated by Dickinson (2011, p.1974), the shake-out classification is not supported by economic theory.

Table 3 provides information about incremental differences in cost asymmetry across the firm life-cycle stages. It is important to note that the dummy variables for each life-cycle stage are interacted with both the sales-up term and the sales-down term from the basic specification. As discussed above, we interpret the base stickiness coefficient as discretionary stickiness – the level of stickiness that would be found at low values of the expansion variables (successive sales decrease, asset intensity, employee intensity, GDP growth, and FCF). The base stickiness for

[16] We have performed the analysis using the log values as well and find that the general results with respect to asset intensity and employee intensity are similar under the alternative specifications.
[17] The results tabulated are based on two-way clustered standard errors with clustering by firm and by year (Petersen, 2009).

mature firms is given by β_2, for intro firms by $\beta_2 + \beta_{10}$, for growth firms by $\beta_2 + \beta_{18}$, and for decline firms by $\beta_2 + \beta_{26}$. Thus, H1A may be tested using β_{10} and β_{18} and H1B may be tested using β_{26}. As predicted, the estimated coefficients β_{10} = -0.1215 (*t*-statistic = -1.73) and β_{18}= -0.1110 (*t*-statistic = -1.91) are significantly negative, supporting H1A that discretionary cost stickiness is greater for intro- and growth-stage firms than for mature firms. The estimated coefficient β_{26} = 0.2359 (*t*-statistic = 3.18) is significantly positive, supporting H1B that discretionary cost stickiness is lower for decline-stage firms.

[Insert table 3 here]

The differences in cost stickiness across life-cycle stages are more easily seen by referring to table 4 where the model is estimated separately for each life-cycle stage. In table 4, the relevant coefficient for discretionary or base cost stickiness is β_2 for each life-cycle stage. The coefficients are similar for the intro-stage (-0.2699, *t*-statistic = -4.22) and the growth-stage (-0.2594, *t*-statistic = -4.64) firms. Referring to the estimation of option values for one-year-ahead sales changes in the appendix, we observe that the similar magnitude of these coefficients is consistent with the similar option values of \$3.65 and \$3.76 for intro- and growth-stages firms, respectively. This similarity extends to the coefficient of -0.1484 (*t*-statistic = -3.93) for mature firms and the option value of one-year-ahead sales changes for mature firms of \$1.70. The numerical relations between the coefficients and the option values are striking. Although not statistically validated, both the coefficients and the option values for the intro- and growth-stage firms are approximately twice the coefficient and option value for mature firms. The coefficient for decline firms of 0.0875 (*t*-statistic = 1.18) is not significantly different from zero and the option value for decline firms is \$0.64 which is less than half the option value for mature firms. Thus, the pattern of the coefficients is consistent with the discretionary slack hypotheses H1A and H1B derived from the pattern of real option values of one-period-ahead revenue changes (appendix).

In addition to discretionary slack retained by managers, frictions in adjusting resources may affect cost stickiness in the short term. Removing assets requires substantial effort and time and entails high adjustment costs. In table 4, we see that cost stickiness increases with asset intensity across all life cycle stages: intro stage coefficient = -0.0806 (*t*-statistic = -2.48), growth stage coefficient = -0.0830 (*t*-statistic = -6.31), mature stage coefficient = -0.0971 (*t*-statistic = -8.90), and decline stage coefficient = -0.1107 (*t*-statistic = -3.52), consistent with hypothesis H2. Keeping in mind that our analysis is about SG&A costs, this indicates that companies retain SG&A resources when sales decline in order to manage assets.

The coefficients for employee intensity are -4.7216 (*t*-statistic = -1.64) for intro-stage firms, 8.7208 (*t*-statistic = 2.36) for growth-stage firms, 7.4860 (*t*-statistic = 3.99) for mature-stage firms, and -9.9481 (*t*-statistic = -5.19) for decline stage firms. This interesting pattern is somewhat different from expectations expressed in hypotheses H3A that employee intensity would contribute less to cost stickiness for mature firms than for early-stage firms and H3B that employee intensity would contribute more to cost stickiness for decline stage firms. In fact, we see that employee intensity has an opposing effect on cost stickiness for growth and mature stage firms, indicating that employee intensity provides more flexibility for cutting SG&A costs for firms in these stages. Employee intensity does contribute to cost stickiness for intro- and decline-stage firms, suggesting that there is less flexibility in adjusting labor for these firms that face more severe resource constraints.

When cutting costs, companies initially reduce discretionary expenditures, cancel capital expenditures, and reduce headcount by removing underperforming employees, combining jobs, and cutting employees not being fully utilized (Coyne et al., 2010). Deeper cuts may remove managers or supervisors and underperforming assets. When reducing headcount, managers are likely to cut employees who do not have firm specific knowledge or skills to save costs during rocky times that can be restored easily when business picks up. On the other hand, employees with firm specific knowledge or skills may be essential to continuing the firms' business and cannot be recaptured in the labor market (Banker et al. 2014c).

From this perspective, the results for decline-stage firms are notable because decline firms have no discretionary cost stickiness (see β_2 in table 4), but have strong stickiness from both asset intensity and employee intensity (see β_4 and β_5 in table 4). This suggests that firms that are classified as decline firms (based on negative operating cash flows and positive cash flows from investing activities) have already trimmed their non-essential employees and are now faced with trimming core employees. Given that decline firms are struggling to survive and may be trying to develop new products and markets, the remaining employees may be critical to them while attracting new employees may be difficult.

In table 4, the estimated coefficient β_3 reveals how a successive sales decline influences cost stickiness. Keeping in mind that companies experiencing a second successive decline in sales have slack resources carried over from the preceding period, the successive decrease coefficient offsets the discretionary or base stickiness for each life-cycle stage. In fact, we see that the coefficient β_3 on the successive decrease term for growth firms (coefficient = 0.2531, *t*-statistic = 6.34) and for mature firms (coefficient = 0.1611, *t*-statistic = 7.02) is similar in magnitude but opposite in sign to the β_2 coefficients for these firms. This indicates that there is no incremental discretionary cost stickiness for these firms in the successive decrease periods. For intro and decline stage firms, the β_3 coefficients of 0.4049 (*t*-statistic = 7.72) and 0.3146 (*t*-statistic = 6.93) are greater in magnitude and opposite in sign to the β_2 coefficients, indicating an incremental anti-stickiness effect for these firms – greater resource cuts in a second period of sales decline. These results are consistent with hypotheses H4A and H4B.

Agency is another element of asymmetric cost behavior (Chen et al. 2012) – managers may retain underutilized resources for personal gratification such as empire-building. Following Chen et al. (2012), we incorporate free cash flow (FCF) into our analysis through the coefficient β_7 in table 4. We see that FCF significantly increases cost stickiness for mature firms (coefficient = 0.0001, *t*-statistic = 2.74), consistent with hypothesis H5.

3.6. Discussion and Conclusion

Our analysis of decision-making when sales decline contributes to both the asymmetric cost behavior literature and the life-cycle literature on firm performance. By documenting that discretionary cost stickiness varies systematically with managerial circumstances represented by firm life cycle, we provide evidence that discretionary slack is a type of real option. The main tension is between resource commitment that creates option value and resource flexibility for dealing with uncertainty (Trigeorgis et al. 2017).

Following previous literature, we investigate how various factors, including asset intensity, employee intensity, successive periods of sales decline, GDP growth, and agency concerns associated with free cash flow, affect cost asymmetry across life-cycle stages. In contrast with asset intensity that slows down resource adjustment across all life-cycle stages, employee intensity increases resource flexibility for growth and mature firms and reflects resource commitment for intro and decline stage firms. This recognition of the alternative roles of employee intensity is not apparent in previous studies that do not separate firms according to life-cycle stage.

We also observe that the loss of optimism associated with successive sales declines is strongest for intro and decline stage firms. The fact that the positive coefficient on the successive sales-decrease variable simply offsets the negative coefficient on the base stickiness variable for growth and mature firms does not necessarily indicate a loss of optimism but a reluctance to increase slack resources beyond the level deemed appropriate after the first decline in sales. We find that the agency issue described by Chen et al (2012), is strongest for the mature stage companies.

In sum, this study enriches the discussion of cost stickiness by providing a more complete explanation of factors affecting managers' decisions to retain slack resources when revenue falls and by highlighting the differences in cost stickiness across different stages of the firm's life cycle. The use of cash flow information to classify firms into life-cycle stages (Dickinson, 2011) illustrates an application of merging cash flow analysis with income statement analysis in evaluating firm performance.

Information about costs and how costs change with revenue is important for evaluating firm performance under different circumstances. Managers in different life-cycle stages try to maximize resource efficiency given both micro- and macro-economic conditions, but market uncertainty makes optimal decision-making about firm resources a complex problem, especially with respect to slack resources that arise when sales decrease. Evidence of different usage of resource slack across life-cycle stages enables information users to consider a more complete picture of firm performance with respect to managers' decision making. From this perspective, this study may contribute to financial analysis by providing contextual information about firms' cost behavior and resource management.

Appendix: Option Value of Revenue Changes by Firm Life-Cycle

In this appendix, we describe Dickinson's method for sorting firms into life-cycle stages. To validate the use of life-cycle stage based on this classification to represent firm circumstances and opportunities that may determine the real option value of slack resources, we estimate the option value of one-year ahead revenue changes for firm-year observations in each life cycle category.

A. Cash Flows Patterns for Life Cycle Classification (Dickinson, 2011)

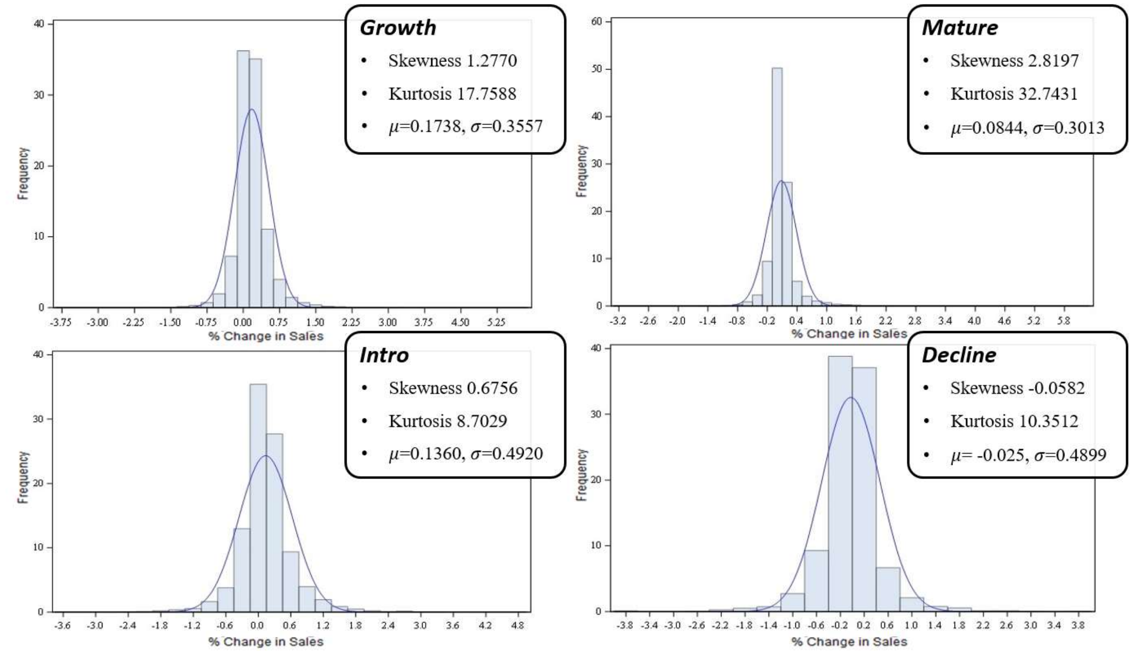
Dickinson identified five stages of firm life cycle – introduction, growth, mature, decline, and shake-out – by mapping threes type of cash flow activities that reflect the underlying product life-cycle stages.

	Operating cash flows	Investing cash flows	Financing cash flows
Intro	-	-	+
Growth	+	-	+
Mature	+	-	-
Decline	-	+	+
	-	+	-

She noted that shake-out stage firms are defined by default if the cash flow patterns do not fit into one of the other defined stages.

B. Distribution of One-Period-Ahead Sales Changes

We sort firm-year observations into life cycle stages following Dickinson (2011). Relying solely on the current year (time t) cash flows for life cycle classifications may be misleading because extraordinary events may distort firms' cash flow patterns. To avoid this problem, a three-year rolling window and a five-year rolling window were used to measure cash flows. Since there is no significant difference between results using the three-year rolling window and five-year rolling window, the three-year rolling window is used to minimize data loss.



The above figure provides the actual distributions of one-period-ahead sales changes for companies in each life cycle classification. The y-axis represents the frequency and the x-axis is the percentage change in sales.

C. Option Value of Future Sales Changes (*t+1*) for Each Life Cycle Stage

To evaluate the option value of slack resources, we consider one-period options where the pay-outs from the options are determined by the change in revenue between t and t+1. The real option values are based on claims to the change in revenues so that the higher the option value, the higher the value of the slack resources the firm would be willing to retain in order to take advantage of a positive change in market demand.

Option Price of Future One-Year-Ahead Sales Changes (Corrado and Su, 1996)

Common Parameters	Firm Life Cycle			Call Price
Time to Expiry: 1 Year **Risk Free Rate:** 10.00% **Dividend Yield:** 0.00%	Intro Stage Firms	Stock Price	$13.60	$3.65
		Strike Price	$13.60	
		Volatility	49.20%	
		Skewness	0.6756	
		Kurtosis	8.7029	
	Growth Stage Firms	Stock Price	$17.38	$3.76
		Strike Price	$17.38	
		Volatility	35.57%	
		Skewness	1.2770	
		Kurtosis	17.7588	
	Mature Stage Firms	Stock Price	$8.44	$1.70
		Strike Price	$8.44	
		Volatility	30.13%	
		Skewness	2.8197	
		Kurtosis	32.7431	
	Decline Stage Firms	Stock Price	$2.50	$0.64
		Strike Price	$2.50	
		Volatility	48.99%	
		Skewness	-0.0582	
		Kurtosis	10.3512	

For option pricing purposes, the stock price and strike price are set equal to the mean value of the percentage sales change by life-cycle group. The mean value represents the relative value of claims to increasing sales for a risk-neutral investor. The option values incorporate the uncertainty associated with the pay-offs from exercising the options. Thus, the analysis incorporates both expectations of managers and uncertainty that affect their decisions to retain slack resources. The estimated option values capture differences in the expected value of the change in sales from an option perspective and monetize the potential option value in a manner consistent with the measurement of the volatility. The estimated option values obtained from our analysis are similar for intro and growth stage firms, $3.65 and $3.76 respectively. For later life-cycle stages, the option values are much lower, $1.70 for mature stage and $0.64 for decline stage firms respectively.

TABLE 3. 1 - Variable Definitions

Variable	Definition
$\ln\Delta SG\&A_{i,t}$	log-change in selling, general, and administrative (SG&A) costs of firm *i* in year *t* relative to year *t*-1.
$\ln\Delta SALES_{i,t}$	log-change in sales revenue of firm *i* in year *t* relative to year *t*-1.
DEC	equals 1 if sales revenue of firm *i* decreased between year *t* and year *t*-1, 0 otherwise.
INT	equals 1 if firms are classified as *introduction* level followed by Dickinson's (2011) cash flow-based life-cycle classification, 0 otherwise.
GRW	equals 1 if firms are classified as *growth* level followed by Dickinson's (2011) cash flow-based life-cycle classification, 0 otherwise.
DCL	equals 1 if firms are classified as *decline* level followed by Dickinson's (2011) cash flow-based life-cycle classification, 0 otherwise.
SHO	equals 1 if firms are classified as *shake-out* level followed by Dickinson's (2011) cash flow-based life-cycle classification, 0 otherwise.
Successive_Dec	equals 1 if sales revenue of firm *i* in year *t*-1 is less than sales revenue in year *t*-2, 0 otherwise.
AssetInt	ratio of total assets to sales revenue at time *t*.
EmpInt	ratio of employee headcount to sales revenue at time *t*.
Growth	GDP growth in year *t*. (Reference: http://www.bea.gov/briefrm/gdp.htm)

TABLE 3. 2 – Data Description and Life Cycle Distribution

Panel A: Descriptive Statistics

		Mean	Std. Dev.	P25	Median	P75
Full	SG&A (millions)	$370.25	$1,335.08	$12.04	$45.26	$182.44
	Sales Revenue (millions)	$1,936.38	$6,601.07	$54.50	$235.22	$1,018.55
	Assets (millions)	$2,115.97	$7,167.53	$20.22	$234.67	$1,051.34
	Employees (thousands)	8.54	27.35	0.28	1.23	5.26
	GDP Growth (percent)	2.55	1.74	1.80	2.70	3.80
	Free Cash Flow (millions)	$205.51	$683.51	$1.02	$15.37	$95.42
Intro	SG&A (millions)	$44.09	$103.76	$5.91	$15.40	$42.50
	Sales Revenue (millions)	$213.92	$660.26	$17.82	$53.36	$167.70
	Assets (millions)	$173.13	$419.55	$14.23	$43.08	$152.36
	Employees (thousands)	1.05	2.80	0.10	0.27	0.85
	GDP Growth (percent)	2.95	1.54	2.20	2.80	4.10
	Free Cash Flow (millions)	-$5.70	$18.40	-$6.59	-$1.52	$0.11
Growth	SG&A (millions)	$296.54	$1,074.19	$17.28	$58.50	$190.98
	Sales Revenue (millions)	$1,677.06	$5,550.96	$90.27	$326.23	$1,079.10
	Assets (millions)	$2,122.10	$6,791.13	$96.56	$369.14	$1,306.96
	Employees (thousands)	7.43	22.75	0.41	1.59	5.60
	GDP Growth (percent)	2.68	1.70	1.80	2.70	4.00
	Free Cash Flow (millions)	$176.27	$559.53	$4.02	$25.52	$106.74
Mature	SG&A (millions)	$644.09	$1,793.06	$21.51	$95.03	$412.27
	Sales Revenue (millions)	$3,283.12	$8,773.89	$117.33	$451.11	$2,231.38
	Assets (millions)	$3,276.30	$8,536.87	$94.54	$458.55	$2,141.08
	Employees (thousands)	13.90	36.36	0.57	2.60	10.33
	GDP Growth (percent)	2.42	1.74	1.70	2.70	3.80
	Free Cash Flow (millions)	$368.86	$929.25	$7.51	$47.60	$245.48
Decline	SG&A (millions)	$39.42	$89.15	$5.44	$13.51	$37.41
	Sales Revenue (millions)	$151.40	$366.82	$15.09	$39.13	$130.48
	Assets (millions)	$130.55	$297.84	$12.07	$33.16	$122.49
	Employees (thousands)	0.88	2.48	0.09	0.22	0.67
	GDP Growth (percent)	2.62	1.71	1.80	2.70	4.00
	Free Cash Flow (millions)	-$4.88	$16.69	-$5.97	-$1.32	$0.15
Shake-Out	SG&A (millions)	$238.25	$1,096.69	$7.63	$25.64	$93.24
	Sales Revenue (millions)	$1,228.09	$5,415.19	$32.82	$121.02	$481.28
	Assets (millions)	$1,423.89	$6,706.38	$31.66	$126.89	$515.40
	Employees (thousands)	5.82	22.06	0.18	0.67	2.89
	GDP Growth (percent)	2.47	1.79	1.60	2.70	3.80
	Free Cash Flow (millions)	$117.50	$517.75	$0.11	$6.44	$39.27

Panel B: Firm Distribution across the Five Firm Life-cycle				
Life-cycle Classification	Number of Firms	Percentage	Cumulative Frequency	Cumulative Percentage
Intro Firms	5,593	6.43%	5,593	6.43%
Growth Firms	24,642	28.34%	30,235	34.77%
Mature Firms	28,460	32.73%	58,695	67.50%
Decline Firms	2,132	2.45%	60,827	69.95%
Shake-out Firms	26,117	30.04%	86,944	100.00%

TABLE 3. 3 – Full Sample Analysis

Regressing annual changes in selling, general, and administrative (SG&A) costs on annual changes in sales for 26-year period 1989-2014.

		Variable	Base Group (Mature Stage)		Incremental (Each Life Cycle)	
			Coefficient	***t*-stat**	**Coefficient**	***t*-stat**
Mature	$\widehat{\beta_0}$	Intercept	0.0124***	4.00		
	$\widehat{\beta_1}$	$\Delta \ln SALES_{i,t}$	0.6401***	19.79		
	$\widehat{\beta_2}$	$DEC\ \Delta \ln SALES_{i,t}$	-0.1484***	-3.94		
	$\widehat{\beta_3}$	$DEC\ \Delta \ln SALES_{i,t}\ Succ\_Dec$	0.1611***	7.03		
	$\widehat{\beta_4}$	$DEC\ \Delta \ln SALES_{i,t}\ AssInt$	-0.0971***	-8.92		
	$\widehat{\beta_5}$	$DEC\ \Delta \ln SALES_{i,t}\ EmpInt$	7.4860***	4.00		
	$\widehat{\beta_6}$	$DEC\ \Delta \ln SALES_{i,t}\ Growth_{i,t}$	-0.0029	-0.60		
	$\widehat{\beta_7}$	$DEC\ \Delta \ln SALES_{i,t}\ FCF_{i,t}$	0.0001***	2.75		
Intro	$\widehat{\beta_8}$	Intercept			-0.0070	-1.07
	$\widehat{\beta_9}$	$\Delta \ln SALES_{i,t}$			0.0291	0.78
	$\widehat{\beta_{10}}$	$DEC\ \Delta \ln SALES_{i,t}$			-0.1215*	-1.73
	$\widehat{\beta_{11}}$	$DEC\ \Delta \ln SALES_{i,t}\ Succ\_Dec$			0.2438***	5.10
	$\widehat{\beta_{12}}$	$DEC\ \Delta \ln SALES_{i,t}\ AssInt$			0.0165	0.50
	$\widehat{\beta_{13}}$	$DEC\ \Delta \ln SALES_{i,t}\ EmpInt$			-12.2076***	-4.35
	$\widehat{\beta_{14}}$	$DEC\ \Delta \ln SALES_{i,t}\ Growth_{i,t}$			-0.0040	-0.24
	$\widehat{\beta_{15}}$	$DEC\ \Delta \ln SALES_{i,t}\ FCF_{i,t}$			0.0013	0.77
Growth	$\widehat{\beta_{16}}$	Intercept			0.0170***	4.50
	$\widehat{\beta_{17}}$	$\Delta \ln SALES_{i,t}$			0.0532**	2.26
	$\widehat{\beta_{18}}$	$DEC\ \Delta \ln SALES_{i,t}$			-0.1110*	-1.91
	$\widehat{\beta_{19}}$	$DEC\ \Delta \ln SALES_{i,t}\ Succ\_Dec$			0.0919***	2.61
	$\widehat{\beta_{20}}$	$DEC\ \Delta \ln SALES_{i,t}\ AssInt$			0.0142	0.98
	$\widehat{\beta_{21}}$	$DEC\ \Delta \ln SALES_{i,t}\ EmpInt$			1.2348	0.29
	$\widehat{\beta_{22}}$	$DEC\ \Delta \ln SALES_{i,t}\ Growth_{i,t}$			-0.0101	-1.45
	$\widehat{\beta_{23}}$	$DEC\ \Delta \ln SALES_{i,t}\ FCF_{i,t}$			1.87E-06	0.04

Decline	$\widehat{\beta_{24}}$	Intercept	-0.0414***	-4.22
	$\widehat{\beta_{25}}$	$\Delta\ln SALES_{i,t}$	-0.1820***	-3.70
	$\widehat{\beta_{26}}$	$DEC\ \Delta\ln SALES_{i,t}$	0.2359***	3.18
	$\widehat{\beta_{27}}$	$DEC\ \Delta\ln SALES_{i,t}\ Succ\_Dec$	0.1534***	3.14
	$\widehat{\beta_{28}}$	$DEC\ \Delta\ln SALES_{i,t}\ AssInt$	-0.0035	-0.12
	$\widehat{\beta_{29}}$	$DEC\ \Delta\ln SALES_{i,t}\ EmpInt$	-17.4341***	-5.93
	$\widehat{\beta_{30}}$	$DEC\ \Delta\ln SALES_{i,t}\ Growth_{i,t}$	-0.0081	-0.84
	$\widehat{\beta_{31}}$	$DEC\ \Delta\ln SALES_{i,t}\ FCF_{i,t}$	-0.0001	-0.04
Shake -Out	$\widehat{\beta_{32}}$	Intercept	0.0085**	1.96
	$\widehat{\beta_{33}}$	$\Delta\ln SALES_{i,t}$	0.0849***	3.34
	$\widehat{\beta_{34}}$	$DEC\ \Delta\ln SALES_{i,t}$	-0.1660***	-3.61
	$\widehat{\beta_{35}}$	$DEC\ \Delta\ln SALES_{i,t}\ Succ\_Dec$	0.2184***	6.65
	$\widehat{\beta_{36}}$	$DEC\ \Delta\ln SALES_{i,t}\ AssInt$	0.0324***	2.59
	$\widehat{\beta_{37}}$	$DEC\ \Delta\ln SALES_{i,t}\ EmpInt$	-6.3427**	-2.45
	$\widehat{\beta_{38}}$	$DEC\ \Delta\ln SALES_{i,t}\ Growth_{i,t}$	-0.0062	-1.18
	$\widehat{\beta_{39}}$	$DEC\ \Delta\ln SALES_{i,t}\ FCF_{i,t}$	0.0000	1.31
		N	83,083	
		Adjusted R^2	0.4690	

TABLE 3. 4 – Separate Analysis for Each Life Cycle Stage

Regressing annual changes in selling, general, and administrative (SG&A) costs on annual changes in sales for 26-Year Period 1989-2014

$$\Delta \ln SG\&A_{i,t} = \beta_0 + \beta_1 \Delta \ln SALES_{i,t} + \beta_2\, DEC\, \Delta \ln SALES_{i,t} + \beta_3 DEC\, \Delta \ln SALES_{i,t}\ \ Succ\_Dec\ + \beta_4 DEC\, \Delta \ln SALES_{i,t}\, AssInt$$
$$+ \beta_5 DEC\, \Delta \ln SALES_{i,t}\, EmpInt + \beta_6 DEC\, \Delta \ln SALES_{i,t} Growth_{i,t} + \beta_7 DEC\, \Delta \ln SALES_{i,t} FCF_{i,t} + \varepsilon_{i,t}$$

	Variable	Intro	Growth	Mature	Decline	Shake-Out	All
$\widehat{\beta_0}$	$Intercept$	0.0054	0.0295***	0.0124***	-0.0290***	0.0209***	0.0160***
		(0.72)	(6.23)	(4.00)	(-2.61)	(4.21)	(4.49)
$\widehat{\beta_1}$	$\Delta \ln SALES_{i,t}$	0.6693***	0.6934***	0.6401***	0.4581***	0.7250***	0.7053***
		(17.68)	(19.14)	(19.76)	(9.02)	(19.59)	(21.76)
$\widehat{\beta_2}$	$DEC * \Delta \ln SALES_{i,t}$	-0.2699***	-0.2594***	-0.1484***	0.0875	-0.3144***	-0.2572***
		(-4.22)	(-4.64)	(-3.93)	(1.18)	(-6.86)	(-6.71)
$\widehat{\beta_3}$	$DEC * \Delta \ln SALES_{i,t} * Successive\_Dec$	0.4049***	0.2531***	0.1611***	0.3146***	0.3796***	0.3093***
		(7.72)	(6.34)	(7.02)	(6.93)	(12.16)	(12.48)
$\widehat{\beta_4}$	$DEC * \Delta \ln SALES_{i,t} * AssInt$	-0.0806**	-0.0830***	-0.0971***	-0.1107***	-0.0648***	-0.0846***
		(-2.48)	(-6.31)	(-8.90)	(-3.52)	(-6.03)	(-10.95)
$\widehat{\beta_5}$	$DEC * \Delta \ln SALES_{i,t} * EmpInt$	-4.7216*	8.7208**	7.4860***	-9.9481***	1.1432	2.0200**
		(-1.64)	(2.36)	(3.99)	(-5.19)	(0.56)	(2.07)
$\widehat{\beta_6}$	$DEC * \Delta \ln SALES_{i,t} * Growth_{i,t}$	-0.0069	-0.0130	-0.0029	-0.0110	-0.0091*	-0.0076*
		(-0.39)	(-1.61)	(-0.60)	(-1.35)	(-1.64)	(-1.67)
$\widehat{\beta_7}$	$DEC * \Delta \ln SALES_{i,t} * FCF$	0.0013	0.0001	0.0001***	-0.0000	0.0001**	0.0001**
		(0.81)	(1.27)	(2.74)	(-0.01)	(2.37)	(2.27)
	N	5,323	23,748	27,618	2,016	24,378	83,083
	R^2	0.4049	0.4477	0.4038	0.3421	0.4848	0.4626

*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent levels (two-tailed), respectively.

Margin Analysis with Respect to $DEC * \ln \Delta SALES_{i,t}$	Direction of Prior Year's Sales	Intro	Growth	Mature	Decline	Shake-Out	All
	Increase	-0.4116	-0.3416	-0.1862	-0.1163	-0.3989	-0.3495
		(-11.69)	(-18.98)	(-13.03)	(-2.12)	(-22.95)	(-39.30)
	Decrease	-0.0067	-0.0885	-0.0251	0.1983	-0.0194	-0.0403
		(-0.18)	(-4.07)	(-1.67)	(3.96)	(-1.10)	(-4.32)

Chapter 4. Are Operating Cash Outflows Sticky?

4.1. Abstract

The sticky costs theory is largely concerned with managers' short-run decisions to adjust cash-consuming resources. Previous literature has documented stickiness in selling, general, and administrative (SG&A) expenses and operating expenses but has not differentiated between operating cash outflows and accruals. Because accruals management and long-term asset accounting may affect observed stickiness in operating costs, it is useful to directly examine stickiness in operating cash outflows. First, we test whether operating cash outflows are sticky and find that they are. Next, we test whether stickiness in operating cash outflows is influenced by short-term financial constraints represented by the current ratio and find that it is. We also test whether stickiness in operating cash outflows is influenced by long-term financial constraints represented by the long-term debt to capital ratio but do not find evidence of such a relation. Third, we recognize that both changes in current levels of activity and long-term capacity affect changes in operating cash outflows. Therefore, we estimate a model of changes in operating cash outflows that includes two drivers, a revenue driver representing changes in current activity and a capacity driver. We find that operating cash outflows are not sticky with respect to changes in revenue but sticky with respect to changes in capacity. Our study contributes to the sticky costs literature by isolating changes in operating cash outflows associated with changes in revenue.

4.2. Introduction

Predicting how costs change with changes in revenue has important implications for budget planning, forecasting earnings, and auditing. Models of cost behavior that have been used traditionally, such as the proportionate costs model, relate cost changes to changes in sales activity but do not allow for asymmetry in cost changes with revenue increases versus revenue decreases. Cost stickiness means that costs do not go down as much when sales activity decreases as they go up when sales activity increases because managers make decisions to retain slack resources created by a drop in revenue activity. Since the large sample observation of this type of cost asymmetry by Anderson, Banker, and Janakiraman (2003), a number of subsequent studies on cost stickiness have been conducted, indicating the importance of investigating cost behavior and stickiness.

The sticky costs theory addresses managers' decisions to make short-run changes to resource commitments when revenue declines based on managers' expectations of future sales and the adjustment costs of retrenching and then ramping up again if sales activity is restored (Anderson et al. 2003; Banker and Byzalov 2014). Previous literature on cost stickiness has used accrual-based accounting expenses such as selling, general, and administrative (SG&A) expenses to measure costs and has not differentiated between cash outflows and accruals. Research indicates that accruals management and long-term cost structure decisions may affect observed stickiness (Kama and Weiss 2012; Balakrishnan, Labro and Soderstrom 2011). Therefore, it is useful to evaluate stickiness in operating cash outflows. Because depreciation and amortization represent resources that are acquired for use in multiple periods and adjustment costs of disposing and acquiring capital assets are high, these accruals might account for a disproportionate part of observed stickiness in operating expenses. Separating operating expenses into operating cash outflows, long-term accruals represented by depreciation and amortization, and other accruals enables us to see how different components of operating expenses contribute to stickiness. We find that operating cash outflows are less sticky than long-term accruals but that removing long-term accruals from operating expenses does not have a large effect on observed stickiness.

The sticky costs literature has identified managerial optimism and adjustment costs for removing and replacing resources as key factors influencing risky decisions to retain slack resources in the face of a decline in revenue activity. Stickiness is associated with greater variability in earnings (Weiss, 2010) so stickiness may be more prevalent in situations where managers have more financial flexibility. We investigate how stickiness in operating cash outflows and long-term accruals is related to balance-sheet ratios that represent financial constraints including the current ratio and the long-term debt to capital ratio. Consistent with the short-term nature of sticky costs, we find that cost stickiness increases with liquidity represented by the current ratio. We do not find that stickiness in operating cash outflows is related to long-term debt to capital.

We extend the sticky costs model of Anderson et al. (2003) by including two cost driver proxies for operating cash outflows, revenue as a “volume” cost driver and “property, plant and equipment (PP&E)” as a “capacity” driver. By specifying the model in this manner, we are performing a stronger test of cost stickiness with respect to current changes in the volume of sales activity. We find that stickiness in operating cash outflows is driven more by the capacity driver than by the revenue driver.

4.3. Background and Hypotheses

Anderson et al. (2003) provided evidence of asymmetric cost behavior for a large sample of compustat firms. They contributed to cost behavior research by interpreting stickiness as the result of deliberate short-run managerial actions corresponding to managers’ consideration of the transaction or adjustment costs of altering resources levels and the likelihood that product demand would be restored in the near future.[18] Following Anderson et al. (2003), Subramaniam and Weidenmier (2003) examined the relation between cost of goods sold (COGS) and sales changes, finding similar evidence of sticky costs. Banker and Chen (2006) and Steliaros, Thomas, and Calleja (2006) studied the variation in adjustment costs across labor markets focusing on selling, general, and administrative (SG&A) expenses.

Around the late 2000s, the study of stickiness became more diversified. Picking up on agency cost arguments as an alternative explanation for managers retaining slack resources (Anderson et al., 2003), Chen, Lu and Sougiannis (2008) investigated the influence of corporate governance in moderating the asymmetric response of cost changes to revenue changes. Dierynck and Renders (2008) studied incentives to manage earnings to moderate the asymmetric response. Banker, Byzalov, Ciftci, and Mashruwala (2014) studied whether the pattern of sales changes moderates the asymmetric response. Following these studies, Banker and Byzalov (2014) synthesized and theorized the literatures on sticky costs. Recently Kama and Weiss (2012) explored motivations underlying managers' resource adjustments with respect to sticky cost and Chen, Gores, and Nasev (2013) investigated the relation between managerial overconfidence and cost stickiness. Homburg et al. (2016) measured firms' cost stickiness as a proxy for slack resources and examined how financial distress affects managers' cost decisions.

Since the large-sample evidence of cost asymmetry provided by Anderson et al. (2003), the sticky costs research has extended its coverage. However a common feature of the studies to date is the use of accrual-based expenses to represent SG&A or operating costs. A criticism of the sticky costs literature is that observed stickiness may be due to long-term cost structure decisions

[18] The term "sticky costs" had previously been used to differentiate between variable costs that change mechanically with volume and lumpy costs that must be removed by managers when sales decline. (Malcolm, 1991)

that cause fixed capacity costs as opposed to short-run resource adjustment decisions made in the current period (Balakrishnan et al., 2011). In fact, Anderson et al. (2003) demonstrated that stickiness increases with fixed asset intensity and employee intensity and argued that adjustment costs are likely to be higher for resources represented by capitalized assets or employees. It remains unclear from the existing research, however, whether depreciation and amortization contribute disproportionately to the observed stickiness in accrued SG&A or operating expenses. Hence, we directly address this question by separating operating expenses into cash flow and accrual components and examining cost behavior across these components.

When sales revenue declines, managers face pressure to reduce operating expenses to shore up reported profits or keep losses down (Kama and Weiss 2012). Because operating expenses include both operating cash outflows and accruals, managers may manage accruals to reduce operating expenses in revenue-down periods. Such reductions would distort observed stickiness. Managers also face pressure to conserve cash in cases where companies' cash resources are strained. These pressures may have a greater influence on operating cash outflows than on long-term accruals because it may be easier and less costly to adjust resources represented by operating cash outflows than resources represented by long-term accruals. For these reasons, we directly investigate stickiness in operating cash outflows.

H1. *Operating cash outflows are sticky.*

The literature on sticky costs has argued that managers' decisions to retain slack resources depend on their optimism and the adjustment costs of removing and replacing resources. Because retaining slack resources is a risky decision that increases earnings variability (Kama and Weiss, 2012), managers' willingness to make such decisions may be influenced by financial flexibility.

Previous studies in the finance literature have regarded cash constraints, liquidity risk, and financial constraints in the same context (Kaplan, and Zingales 1997; Moyen 2004; Denis and Sibilkov 2009) by identifying the term 'liquidity' as the ability of an enterprise to generate adequate amounts of cash to meet the enterprise's needs for cash. The current ratio is a key ratio used to indicate liquidity and is often used in debt covenants. The influence of liquidity on managers' decisions to cut or retain resources when revenue declines may be greater for cash operating outflows than for long-term accruals. Therefore, we make the following second hypothesis.

H2. *Stickiness of operating cash outflows increases with liquidity as represented by the current ratio*.

Another dimension of financial flexibility is the extent to which a firm is financed by long-term debt versus equity. Long-term debt may influence short-term decisions to retain slack resources because debt-servicing requirements are rigid and debt agreements impose restrictive covenants on managers. Therefore, managers facing greater long-term financial constraints, represented by the ratio of long-term debt to capital, may avoid making risky decisions to retain slack resources. Following this expectation, we state our third hypothesis as follow.

H3. *Stickiness in cash operating outflows increases with the long-term debt to capital ratio.*

4.4. Empirical Models

To investigate stickiness of operating cash outflows, we used the Compustat annual data of North American firms for firm fiscal years from 1990 to 2016. Panel A of Table 1 provides descriptive information about two measures of annual operating expenses (excluding and including depreciation and amortization), operating cash outflows, depreciation and amortization, sales revenue, and gross PP&E variables for the complete 27-year sample. All reported numbers are in millions of dollars. Correlations between the main variables are provided in Panel B of Table 1.

[Insert Table 1]

We conduct this study with operating expenses rather than SG&A costs because of the ability to observe cash outflows for operating expenses (Weiss, 2010). With this pool of data, the first stage of our empirical analysis is to extract cash outflow and accrual information for operating items because this information is not directly shown in the financial statements. The steps to calculate operating expenses and operating cash outflow information are as following.

Operating expenses are the difference between sales revenue and operating income. Because there are two types of operating income – 'operating income *before* depreciation' and 'operating income *after* depreciation', this calculation yields two measures of operating expenses: operating expenses before depreciation (excluding depreciation and amortization) and operating expenses after depreciation (including depreciation and amortization). Operating cash outflows are obtained by subtracting operating cash flows from cash revenues after removing interest expense and the current portion of the income tax provision.

After getting the cash outflow and accrual information for operating items described in the previous section, we run the empirical analysis with the following model based on the study of Anderson et al. (2003). A description of the Anderson et al. model is

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

In the Anderson et al. study (2003), the dependent variable is SG&A costs (reported SG&A expense) rather than operating costs. Because our study is aimed at analyzing the behavior of operating cash outflows and accruals, "Operating Expenses" is used as the primary dependent variable. Four specific models are below.

$$\log\left[\frac{\boldsymbol{Operating\ Expenses\ (After\ Dep.)_{i,t}}}{\boldsymbol{Operating\ Expenses\ (After\ Dep.)_{i,t-1}}}\right]$$

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

$$\log\left[\frac{\boldsymbol{Operating\ Expenses\ (Before\ Dep.)_{i,t}}}{\boldsymbol{Operating\ Expenses\ (Before\ Dep.)_{i,t-1}}}\right]$$

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

$$\log\left[\frac{\boldsymbol{Operating\ Cash\ Outflows_{i,t}}}{\boldsymbol{Operating\ Cash\ Outflows_{i,t-1}}}\right]$$

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

$$\log\left[\frac{\boldsymbol{Depreciation\_and\_Amortization_{i,t}}}{\boldsymbol{Depreciation\_and\_Amortization_{i,t-1}}}\right]$$

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

where,

'Decrease_Dummy'= 1 when sales revenue decreases between period t-1 and t, and 0 otherwise.

The ratio form and log specification is used to enhance comparability of the variables and to reduce potential heteroskedasticity. Therefore the β coefficients in the model can be interpreted in the following manner.

$\boldsymbol{\beta_1}$: % increase in cash operating outflows with a 1% ***increase*** in sales revenue.

$\boldsymbol{\beta_1 + \beta_2}$: % decrease in cash operating outflows with a 1% ***decrease*** in sales revenue.

Stickiness is observed when $\boldsymbol{\beta_2}$ is significantly negative. Thus, separate tests of stickiness are conducted for operating expenses (excluding and including depreciation), operating cash outflows, and depreciation and amortization.

4.5. Analysis and Results

We present the results of estimating the four models in table 2. In the model with dependent variable of operating expense (ADP) in panel A, the estimated value of $\widehat{\beta_1}$ of 0.5977 (*t-statistic* = 16.89) indicates that 'Operating Expenses (ADP)' increased 0.59% per 1% increase in sales revenues. The value of $\widehat{\beta_2}$ = -0.1174 (*t-statistic* = - 3.71) provides strong evidence for the sticky costs hypothesis. The sum of both $\widehat{\beta_1} + \widehat{\beta_2}$ =0.4803 indicates that operating expenses (ADP) decreased only 0.48% when sales revenue decreased 1% (versus 0.59% when revenue increased). The fact that $\widehat{\beta_1}$ and $\widehat{\beta_1} + \widehat{\beta_2}$ are both significantly less than one (*p*-values=0.001) indicates that changes in operating expenses (ADP) were not proportional to changes in revenue.

[Insert Table 2]

Our primary interest is in the model with operating cash outflows as the dependent variable, where we see strong evidence of cost stickiness, supporting H1. We use the ratio of $(\widehat{\beta_1} + \widehat{\beta_2})$ / $(\widehat{\beta_1})$ to compare stickiness across the models. A lower value of this ratio indicates more stickiness. In case of depreciation and amortization, the ratio is 0.5774, stickier than operating cash outflows. The estimations between operating expenses after depreciation (ADP) and operating expenses before depreciations (BDP) indicate that while depreciation and amortization by itself is sticky, removing depreciation and amortization does not nullify stickiness in other components of operating expense. We also see that there is a small change in the ratio between operating expenses (BDP) and operating cash outflows. The difference between these models is "other accruals". The small difference in the ratio suggests that other accruals do not play a large role in observed stickiness.

We investigate how financial constraints influence stickiness in operating expenses, operating cash outflows, and depreciation and amortization. To test the second and third hypotheses, we expanded the sticky costs term to include the current ratio and long-term debt to capital as measures of financial constraints.[19] The results of estimations with financial constraints are tabulated in table 3.

[Insert Table 3]

For operating expense (ADP), the estimated value of $\widehat{\beta_1}$ of 0.5724 (t-statistic = 14.95) indicates that 'Operating Expenses' increased 0.57% per 1% increase in sales revenues. The value of $\widehat{\beta_2}$ = -0.1859 (t-statistic = -1.95) is consistent with the sticky costs hypothesis but in this case represents the stickiness that is not partially explained by the financial constraint variables. The sticky coefficients for the two financial constraints, long-term debt to capital and current ratio, are 0.1220 (*t-statistic* = 3.95) and -0.0024 (*t-statistic* = -2.27) respectively. The significantly negative coefficient for the current ratio indicates that operating cost stickiness increases with the current ratio, consistent with H2 that managers are more willing to retain slack resources when they have more short-term financial flexibility. The significantly positive coefficient for the long-term debt to capital suggests that operating expenses are stickier for companies with higher leverage, inconsistent with H3. The results for the operating expense before depreciation (BDP) and operating cash outflows are similar to those for the operating expense after depreciation (ADP) model in the sense that the sticky coefficient on the current ratio terms are significantly negative and the sticky coefficient on the long-term debt to capital terms do not show stickiness, supporting H2 but not H3.

In summary, the empirical analysis with financial constraints provides new evidence that the stickiness in operating cash outflows increases with liquidity, suggesting that managers are

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[19] Following ABJ, we expand the sticky costs term by interacting the revenue Decrease_Dummy * log $\left[\frac{Revenue_{i,t}}{Revenue_{i,t-1}}\right]$ with the current ratio and the long-term debt to capital ratio.

more likely to retain slack resources in revenue-down periods when their firms have more short-term financial flexibility. The results do not support the hypothesis H3 that stickiness in operating cash outflows decreases with the long-term debt to capital ratio.

Multiple Cost Drivers

In this section, we include property, plant and equipment (PP&E) as a second cost driver because costs such as labor and overhead depend on resources that are required to support the capacity represented by PP&E. This leads to an extension of the Anderson et al. (2003) model where sales revenue is a "volume of activity" driver and PP&E is a "capacity" cost driver. In this model with two cost drivers, a term is included for the change in PP&E between period t and period t – 1 and another term is included that interacts the revenue decrease dummy with the change in PP&E between periods. Thus, the interpretation of the coefficients for these two new terms, $\widehat{\beta_3}$ and $\widehat{\beta_4}$, for the "capacity" cost driver corresponds to the interpretation of $\widehat{\beta_1}$ and $\widehat{\beta_2}$ for the "volume of activity" cost driver. The estimated $\widehat{\beta_3}$ represents the percentage change in operating costs for a 1% change in PP&E in sales-increase periods and the sum of $\widehat{\beta_3}$ and $\widehat{\beta_4}$ represents the percentage change in operating costs for a 1% change in PP&E in sales-decrease periods. It is important to observe that we do not interpret costs to be fixed across periods as in Balakrishnan et al. (2011). It is reasonable to expect that fixed costs will change across periods as new assets are added to accommodate increases in sales or old assets are removed in periods when sales decline.[20]

A difference from our earlier analysis above is that we can only use PP&E as a cost driver proxy when we look at operating expenses excluding depreciation and amortization (BDP) or operating cash outflows. The magnitude of the coefficient $\widehat{\beta_3}$ depends on the fraction of operating costs or operating cash outflows that are tied to long-term assets represented by PP&E. The

[20] For instance, companies may remove underperforming assets in periods when sales decline.

magnitude of $\widehat{\beta_4}$ depends on how operating costs or operating cash outflows change with respect to changes in PP&E in revenue-decrease periods. In other words, the model addresses the question whether companies retain slack resources resulting from a decrease in the long-term assets represented by PP&E.

Our expectation for the coefficient $\widehat{\beta_2}$ is different in the new model because this coefficient now represents the stickiness in operating expenses or operating cash outflows after removing the stickiness in operating costs associated with long-term resources represented by PP&E. This enables a stronger test of our hypothesis 1 because we are not only excluding depreciation and amortization from operating costs, but we are also separating out operating costs associated with the assets represented by PP&E.

Table 4 presents results of estimating this two-driver version of the sticky costs model. We find that the coefficient $\widehat{\beta_2}$ is not significantly negative indicating that stickiness in operating cash outflows with respect to revenues is weaker when we include a second cost driver for capacity. We also find that the estimated $\widehat{\beta_4}$ is significantly negative and reasonably large in magnitude relative to $\widehat{\beta_3}$. This indicates that operating cost reductions when such capacity are removed in revenue-decrease periods are less than operating costs increases when such capacity are added in revenue-increase periods.

[Insert Table 4]

4.6. Conclusion

The term 'bankruptcy in black' (or insolvency by paper-profits) indicates a situation where a bankruptcy occurs because of low or negative cash flow even though a firm is generating profits according to its operating statement. This is a representative case implying the importance of cash flow management. While prior studies related to stickiness have shed light on asymmetry in firms' cost behavior, our research considers the application of this research to cash flow management.

Our research findings provide motivation to investigate differences between accrual and cash flow measurement, especially with regard to differences in the behavior of these components in relation to changes in sales revenue. Expense measurement using accruals is dominant in accounting, based on the economic perspective that accruals provide information about resource consumption. Earnings forecasts for internal and external purposes typically forecast operating expenses as a percentage of sales revenue without considering differences in cash flows and accruals. By considering cost changes separately for accrual and cash flow measurements, managers and stakeholders may make more informed decisions in managing their costs.

Moreover, income-increasing discretionary accruals have been regarded as evidence of earnings management. It may be useful to consider implications of differences in cost behavior for cash flows and accruals when estimating discretionary accruals to detect earnings management. Our extension of the earlier sticky costs model to include "volume" and "capacity" cost drivers may also provide new avenues for future research.

TABLE 4. 1 – Descriptive Statistics

Panel A: Data Description

	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile
Operating Expense (ADP) (including Depreciation)	\$2,352.52	\$11,176.52	\$240.87	\$51.35	\$1,085.62
Operating Expense (BDP) (excluding Depreciation)	\$2,197.92	\$10,595.59	\$222.51	\$47.81	\$1,005.31
Operating Cash Outflows	\$2,159.07	\$10,385.77	\$214.10	\$45.45	\$983.08
Sales Revenue	\$2,629.85	\$12,258.27	\$261.46	\$52.51	\$1,214.34
Gross PP&E	\$2,341.17	\$12,308.38	\$101.34	\$15.56	\$703.03
Depreciation & Amortization	\$154.60	\$798.75	\$10.34	\$1.79	\$57.70

Panel B: Pearson Correlations (p-values reported below correlations)

	$\Delta\ln OPEXP(ADP)$	$\Delta\ln OPEXP(BDP)$	$\Delta\ln OPCOF$	$\Delta\ln SALES$	$\Delta\ln PP\&E$	$\Delta\ln D\&A$
$\Delta\ln OPEXP(ADP)$	1.0000					
$\Delta\ln OPEXP(BDP)$	0.9882 <.0001	1.0000				
$\Delta\ln OPCOF$	0.7913 <.0001	0.7836 <.0001	1.0000			
$\Delta\ln SALES$	0.7929 <.0001	0.7797 <.0001	0.7118 <.0001	1.0000		
$\Delta\ln PP\&E$	0.5255 <.0001	0.5042 <.0001	0.4321 <.0001	0.4599 <.0001	1.0000	
$\Delta\ln D\&A$	0.6096 <.0001	0.5422 <.0001	0.4811 <.0001	0.4990 <.0001	0.5441 <.0001	1.0000

TABLE 4. 2 – Stickiness in Operating Expense, Cash Flows, and Depreciation and Amortization

Panel A: Basic Model

	DV: Operating Expense (ADP)	DV: Operating Expense (BDP)	DV: Operating Cash Outflows	DV: Depreciation & Amortization
	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)
Intercept	0.0300***	0.0301***	0.0275***	0.0378***
	(7.19)	(7.00)	(5.94)	(4.27)
$\Delta\ln SALES$	0.5977***	0.5963***	0.6313***	0.5895***
	(16.89)	(16.67)	(17.02)	(17.75)
$DEC\ \Delta\ln SALES$	-0.1174***	-0.1066***	-0.0847***	-0.2491***
	(-3.71)	(-3.30)	(-2.90)	(-8.60)
N	107,312	107,312	107,312	107,312
R^2	0.5475	0.5272	0.4163	0.2330

Panel B: Expanded Model with Anderson et al. (2003) Control Variables

	DV: Operating Expense (ADP)	DV: Operating Expense (BDP)	DV: Operating Cash Outflows	DV: Depreciation & Amortization
	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)
Intercept	0.0491***	0.0497***	0.0484***	0.0481***
	(10.80)	(10.60)	(9.18)	(5.45)
$\Delta\ln SALES$	0.5727***	0.5706***	0.6038***	0.5760***
	(15.46)	(15.24)	(15.41)	(16.82)
$DEC\ \Delta\ln SALES$	-0.1399	-0.1365	-0.1383	-0.2605***
	(-1.64)	(-1.51)	(-1.63)	(-3.27)
$DEC\ \Delta\ln SALES$*$Succ\_DEC$	0.1375***	0.1339***	0.0828***	0.2223***
	(6.71)	(6.49)	(3.12)	(7.08)
$DEC\ \Delta\ln SALES$*$Growth_{i,t}$	-0.0052	-0.0059	0.0016	0.0031
	(-0.64)	(-0.60)	(0.16)	(0.35)
$DEC\ \Delta\ln SALES$*ln$Asset_Int$	-0.0754***	-0.0756***	-0.0758***	-0.0549***
	(-5.95)	(-5.47)	(-6.34)	(-4.62)
$DEC\ \Delta\ln SALES$*lnEmp_Int	-0.0583***	-0.0617***	-0.0714***	-0.0177
	(-4.90)	(-4.82)	(-5.74)	(-1.57)
N	107,312	107,312	107,312	107,312
R^2	0.6089	0.5886	0.4632	0.2460

TABLE 4. 3 – Stickiness with Financial Constraints

Comparison with Four Dependent Variables				
	DV: Operating Expense (ADP)	DV: Operating Expense (BDP)	DV: Operating Cash Outflows	DV: Depreciation & Amortization
	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)	Coefficient (*t*-stat)
Intercept	0.0496***	0.0502***	0.0491***	0.0480***
	(10.91)	(10.75)	(9.11)	(5.50)
$\Delta \ln SALES$	0.5724***	0.5705***	0.6058***	0.5775***
	(14.95)	(14.71)	(14.72)	(16.44)
$DEC\ \Delta \ln SALES$	-0.1859*	-0.1868*	-0.2339***	-0.2664***
	(-1.95)	(-1.85)	(-2.76)	(-3.18)
$DEC\ \Delta \ln SALES$*$Succ\_DEC$	0.1358***	0.1326***	0.0917***	0.2117***
	(7.67)	(7.71)	(4.39)	(5.98)
$DEC\ \Delta \ln SALES*Growth_{i,t}$	-0.0077	-0.0082	0.0018	0.0017
	(-0.95)	(-0.89)	(0.21)	(0.19)
$DEC\ \Delta \ln SALES$*ln$Asset_Int$	-0.0699***	-0.0699***	-0.0635***	-0.0501***
	(-5.16)	(-4.70)	(-5.42)	(-4.08)
$DEC\ \Delta \ln SALES$*lnEmp_Int	-0.0590***	-0.0625***	-0.0788***	-0.0229**
	(-4.44)	(-4.35)	(-6.58)	(-2.09)
$DEC\ \Delta \ln SALES$*Long-term Debt to Capital	0.1220***	0.1344***	0.1441***	-0.0332
	(3.95)	(4.36)	(3.90)	(-1.26)
$DEC\ \Delta \ln SALES$*Current Ratio	-0.0024**	-0.0027***	-0.0036***	-0.0008
	(-2.27)	(-2.61)	(-3.59)	(-0.39)
N	102,282	102,282	102,282	102,282
R^2	0.6130	0.5946	0.4898	0.2493

TABLE 4. 4 – Stickiness with Two Cost Drivers

	DV: Operating Expense (BDP)	DV: Operating Cash Outflows
	Coefficient (t-stat)	Coefficient (t-stat)
Intercept	0.0178***	0.0163***
	(4.60)	(3.76)
$\Delta\ln SALES$	0.5045***	0.5461***
	(13.82)	(13.78)
$DEC * \Delta\ln SALES$	-0.0617*	-0.0375
	(-1.86)	(-1.19)
$\Delta\ln PP\&E$	0.2123***	0.1962***
	(11.84)	(9.50)
$DEC * \Delta\ln PP\&E$	-0.0651***	-0.0827***
	(-3.81)	(-3.18)
N	107,312	107,312
R^2	0.5651	0.4367

Chapter 5. Conclusion

Costs are part of our daily life and cost management has been at the center of debates in both academia and industry because of its significance. Accordingly, many previous studies investigate cost behavior and its drivers to obtain a better sense of costs. My dissertation is in line with this continuous effort to understand costs. It makes three distinct empirical contributions to the growing literature on asymmetric cost behavior.

My first study recognizes that costs are determined by multiple drivers including volume and capacity. This has important implications for analysis of costs across periods. Activity-based costing (ABC) uses multiple cost drivers to allocate costs to products. I apply similar reasoning to cost changes between periods. Adding a cost driver to the asymmetric cost behavior (ACB) model contributes to the comprehension of cost behavior. By improving the specification of asymmetric cost behavior models, my analysis helps to distinguish between the effects of short-run volume-related resource adjustments and longer-run capacity-related resource adjustments that occur across periods. This clear distinction between two different types of resource adjustment can result in better management.

To date, little attention has been paid to cost prediction in the financial accounting literature. Banker and Chen (2006) demonstrated that an earnings prediction model based on differences in cost behavior when sales increase and when sales decline outperformed other time-series models for predicting earnings. Such prediction models may also be enhanced by including multiple cost drivers and contextual factors that influence how costs change between periods.

My second study recognizes that managers' decision-making to retain or release committed resources depends on the circumstances of the firm and relates cost behavior when sales decline to the life-cycle stage of the firm. Other ACB studies have discriminated between optimistic and pessimistic circumstances based on the direction of sales in the previous year. By adopting life-cycle analysis, my research expands the coverage of cost behavior analysis and provides more information about contextual settings in which the observation of different managerial decisions about slack resources is meaningful.

Moreover, this study articulates a real options approach to managing slack resource adjustments when sales decline. The value of slack resources has been a persistent discussion of interest to managers and scholars. Framing managers' decision-making about slack resources as real option decisions provides a new way to appraise slack resources and asymmetric cost behavior. My empirical evidence that slack resources play a pivotal role as real options is different from the discussion of optimism in prior studies. By approaching slack resource decisions in the context of firm life cycle, I add another dimension and offer a structure to optimism described in previous research on asymmetric cost behavior. This moves one step further to a more complete understanding of managers' resource-adjustment decisions that incorporates both expectations and uncertainty.

Finally, this research recognizes that there may be differences between cost behavior related to cash flows and accruals and tests whether these differences affect the analysis of asymmetric cost behavior. In addition, it also considers how financial constraints influence managers' decisions to retain or release resources. Cash flow is an important consideration to managers. Especially in an uncertain business environment, the importance of cash flow management increases. Since most prior studies of asymmetric cost behavior have been conducted with accrual information such as selling, administrative, and general (SG&A) expense and costs of goods sold (COGS), investigating the relationship between operating cash outflows and changes in activity volume offers a new dimension to the asymmetric cost behavior literature.

My research has important implications for managers. Managing costs and resources when sales increase and decline is an important management activity and these decisions are up to managerial judgement and discretion. Little attention has been paid to this problem in management accounting textbooks that frame decision-making based on the fixed and variable cost model. My studies provide information that may be used to develop a richer exposition of the resource adjustment problem. In turn, my research enlightens not only managerial accounting but also financial accounting by describing how costs change over time conditional on different management circumstances.

A notable contribution of my research is to open new avenues for extending cost behavior research. In particular, future research may get finer insights about costs from analyzing detailed cost information from individual companies or by looking at resource adjustment in specific industries. Such research may be enhanced by using an expanded cost behavior model with two cost drivers or by considering different managerial circumstances across firm life-cycle stages. After all, such continuing investigations will help stakeholders understand costs better, leading to higher quality financial reporting, and better decision making, resulting in more optimal use of scarce resources.

References

Adler, P.S., Benner, M., Brunner, D.J., MacDuffie, J.P., Osono, E., Staats, B.R., Takeuchi, H., Tushman, M. and Winter, S.G., 2009. Perspectives on the productivity dilemma. *Journal of Operations Management* 27(2): 99-113.

Amarm, M. and Kulatilaka, N. 1999. *Real Options: Managing Strategic Investment in an Uncertain World*. Harvard Business School Press, Boston, MA.

Anderson, M., Banker, R., and Janakiraman, S. 2003. Are selling, general, and administrative Costs 'Sticky?' *Journal of Accounting Research* 41(1): 47-63.

Anderson, M., Banker, R., Huang, R., and Janakiraman, S. 2007. Cost Behavior and Fundamental Analysis of SG&A Costs. *Journal of Accounting, Auditing, & Finance* 22(1): 1-28.

Anderson, S.W. and W. N. Lanen. 2009. *Understanding cost management: What can we learn from the empirical evidence on "Sticky Costs?"* Working Paper, Rice University.

Azadegan, A., Patel, P., Parida, V. 2013. Operational Slack and Venture Survival. *Production and Operation Management Society* 22(1): 1-18.

Anthony, J. and Ramesh, K. 1992. Association between Accounting Performance Measures and Stock Prices. *Journal of Accounting and Economics* 15(2): 203-227.

Bourgeois, L. 1981. On the Measurement of Organizational Slack. *The Academy of Management Review.* 6(1): 29-39.

Banker, R., and Byzalov, D. 2014a. Asymmetric Cost Behavior. *Journal of Management Accounting Research* 26(2): 43-79.

Banker, R., Basu, S., Byzalov, D., and Chen, J., 2013. *Asymmetries in Cost-Volume-Profit Relation: Cost Stickiness and Conditional Conservatism*. Working Paper. Temple University.

Banker, R., Byzalov, D. and Chen. L. 2013b. Employment protection legislation, adjustment costs and cross-country differences in cost behavior. *Journal of Accounting and Economics* 55(1): 111-127.

Banker, R., Byzalov, D., Ciftci, M., and Mashruwala, R. 2014b. The moderating effect of prior sales changes on asymmetric cost behavior. *Journal of Management Accounting Research* 26 (2): 221-242.

Brush, T.H., Bromiley, P. and Hendrickx, M., 2000. The Free Cash Flow Hypothesis for Sales Growth and Firm Performance. *Strategic Management Journal* 21(4):455-472.

Banker, R., Byzalov, D. and Plehn-Dujowich, J. M., 2013a. Demand uncertainty and cost behavior. *The Accounting Review* 89(3): 839-865.

Banker, R. and Chen, L. 2006. Predicting earnings using a model based on cost variability and cost stickiness. *The Accounting Review* 81(2): 285-307.

Banker, R., Ciftci, M., and Mashruwala, R. (2010). *Managerial Optimism, Prior Period Sales Changes and Sticky Cost Behavior*. Working Paper. Temple University.

Banker, R. and Flasher, R., and Zhang, D. 2014c. *Strategic Positioning and Asymmetric Cost Behavior.* Temple University Working Paper.

Balakrishnan, R. and Gruca, T. 2008. Cost Stickiness and Core Competency: A Note. *Contemporary Accounting Research* 25(4): 993-1006.

Bowman, E. H., and Hurry, D. 1993. Strategy through the option lens: An integrated view of resource investments and the incremental-choice process. *Academy of Management Review* 18(4): 760-782.

Banker, R. D. and H. H. Johnston. 1993. An empirical study of cost drivers in the U.S. airline industry. *The Accounting Review* 68 (3): 576-601.

Benaroch, M. and Kauffman, R. J. 2000. Justifying electronic banking network expansion using real options analysis, *MIS Quarterly* 24(2): 197-225.

Balakrishnan, R., Labro, E., and Soderstrom, N. 2014. Cost Structure and Sticky Costs. *Journal of Management Accounting Research* 26(2): 91-116.

Balakrishnan, R., Peterson, M., and Soderstrom, N. 2004. Does capacity utilization affect the "stickiness" of costs? *Journal of Accounting, Audit & Finance* 19(3): 283-300.

Barclay, M. J. and Smith, C. W. 2005. The capital structure puzzle: The evidence revisited. *Journal of Applied Corporate Finance* 17(1): 8-17.

Bradley, S., Shepherd, D., and Wiklund, J. 2011. The Importance of Slack for New Organizations Facing ‘Tough’ Environment. *Journal of Management Studies* 48(5):1071-1097.

Brennan, M. and Swartz, E. 1985. A new approach to evaluating natural resource investments. *Midland Corporate Finance Journal*, 3(1): 37-47.

Caves, R. 1998. Industrial Organization and New Findings on the Turnover and Mobility of Firms. *Journal of Economic Literature* 36(4): 1947-82.

Coyne, K.P., Coyne, S.T. and Coyne, E.J., 2010. When you’ve got to cut costs now. *Harvard Business Review*, 88(5), pp.74-82.

Chen, C., Gores, T., and Nasev, J. 2015. *Managerial Overconfidence and Cost Behavior*. Working Paper. University of Illinoi at Urbana-Champaign.

Cohen, M. A. and Huchzermeier, A. 1999. Global supply chain management: a survey of research and applications. *Quantitative Models for Supply Chain Management*, Kluwer, Boston, MA, pp. 669-702.

Chen, C., Lu, H., and Sougiannis, T. 2012. The Agency Problem, Corporate Governance, and the Asymmetrical Behavior of Selling, General, and Administrative Costs. *Contemporary Accounting Research* 29(1): 252-282.

Chopra, S. and Sodhi, M. 2004. Managing Risk to Avoid Supply-Chain Breakdown. *Slone Management Review*: 46(1):53.

Corrado, C.J. and Su, T., 1996. Skewness and kurtosis in S&P 500 index returns implied by option prices. *Journal of Financial research* 19(2): 175-192.

Ciftci, M., R. Mashruwala, and D. Weiss. 2016. Implications of cost behavior for analysts' earnings forecasts. *Journal of Management Accounting Research* 28 (1): 57-80.

Cyert, R. and March, J. 1963. *A Behavior Theory of the Firm*. Prentice Hall, Englewood Cliffs, NJ.

Cooper, R. and R. S. Kaplan. 1998. Measure costs right: Make the right decisions. *Harvard Business Review* 66 (5): 96-103.

Cooper, R. and R. S. Kaplan. 1991. *The design of cost management systems: Text, cases, and readings*. Englewood Cliffs, NJ: Prentice-Hall.

Cooper, R. and Kaplan, R. 1992. Activity-Based Systems: Measuring the Costs of Resource Usage. *Accounting Horizons* 6(3): 1-13.

Calleja, K., Steliaros, M., and Thomas, D. 2006. A note on cost stickiness: Some international comparisons. *Management Accounting Research* 17: 127-140.

Clemons, E. K. and Weber, B. 1990. Strategic information technology investments: guideline, *Journal of Management Information Systems*, 7(2): 9-28.

Dickinson, V. 2011. Cash Flow Patterns as a Proxy for Firm Life Cycle. *The Accounting Review* 86(6): 1969-1994.

Dierynck, B., Landsman W.R., and Renders, A. 2012. Do Managerial Incentives Drive Cost Behavior? Evidence about the Role of the Zero Earnings Benchmark for Labor Cost Behavior in Private Belgian Firms. *The Accounting Review* 87(4): 1219-1246.

Dixit, A. K. and Pindyck, R. S., 1995. The options approach to capital investment. *Real Options and Investment under Uncertainty-classical Readings and Recent Contributions.* MIT Press, Cambridge, p.6.

Denis, D. and Sibilkov, V. 2010. Financial Constraints, Investment, and the Value of Cash Holdings. *The Review of Financial Studies* 23: 247-269.

Folta, T. B. 1998. Governance and Uncertainty: The Trade-off between Administrative Control and Commitment. *Strategic Management Journal* 19: 1007-1028.

Hatch, N. W. and J. H. Dyer. 2004. Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal* 25 (12): 1155-1178.

Hitt, M. A., L. Bierman, K. Shimizu, and R. Kochhar. 2001. Direct and moderating effects of human capital on strategy and performance in professional firms: a resource-based perspective. *Academy of Management Journal* 44 (1): 13-28.

Horngren, C. T, S. Datar, and M. Rajan. 2015. *Cost Accounting* (15th Edition). New York, NY: Pearson Inc.

Homburg, C. and Nasev, J. 2008. How timely are earnings when costs are sticky? Implication for link between conditional conservatism and cost stickiness. Working Paper. University of Cologne.

Homburg, C. Nasev, J., and Richter, C. 2016. Corporate Financial Distress and Slack Resources. Working Paper. University of Cologne.

Hendricks, K. and Singhal, V. 2005. An Empirical Analysis of the Effect of Supply Chain Disruptions on Long-Run Stock Price Performance and Equity Risk of the Firm. *Production and Operation Management Society* 14(1): 35-52.

Hribar, P. and Yehuda, N. 2015. The Mispricing of Cash Flows and Accruals at Different Life-Cycle Stages. *Contemporary Accounting Research* 32 (3): 1053-1072.

Ingersoll, J. and Ross, S. 1992. Waiting to invest: investment and uncertainty. *Journal of Business* 65(1): 1-29.

Jensen, M.C. and Meckling, W.H., 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics* 3(4): 305-360.

Jovanovic, B. 1982. Selection and the Evolution of Industry, *Journal of the Econometric Society* 50(3): 649-670.

Jovanovic, B. and G. MacDonald. 1994. The Life Cycle of a Competitive Industry. *Journal of Political Economy* 102(2): 322-347.

Kogut, B. 1991. Joint ventures and the option to expand and acquire. *Management Science* 37(1): 19-33.

Kaplan, R. S. and Cooper, R. 1998. *Cost & Effect: Using Integrated Cost Systems to Drive Profitability and Performance*. Harvard Business Press.

Kama, I. and Weiss, D. 2013. Do Earnings Targets and Managerial Incentives Affect Sticky Costs? *Journal of Accounting Research* 51(1):201-224.

Kaplan, S. and Zingales, L. 1997. Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? *The Quarterly Journal of Economics* 112: 169-215.

Kaplan, S. and Zingales, L. 2000. Investment-Cash Flow Sensitivities Are Not Valid Measures of Financing Constraints. *The Quarterly Journal of Economics* 115: 707-712.

Leibenstein, H. 1969. Organizational of Frictional Equilibria, X-Efficiency, and the Rate of Innovation. *The Quarterly Journal of Economics* 83(4): 600-623.

Litschert, R. and Bonham T. 1978. A Conceptual Model of Strategy Formation. *The Academy of Management Review* 3(2): 211-219.

Malcom, R. E., 1991. Overhead control implications of activity costing. *Accounting Horizons*, *5*(4): 69-78.

Malik, M. 2012. *A Review and Synthesis of "Cost Stickiness" Literature*. Working Paper. Boston University.

McGrath, R. G. 1997. A real options logic for initiating technology positioning investments. *Academy of Management Review* 22(4): 974-996.

McInnis, J. 2010. Earnings Smoothness, Average Returns, and Implied Cost of Equity Capital. *The Accounting Review* 85: 315-342.

Meyer, A. 1982. Adapting to Environmental Jolts. *Administrative Science Quarterly* 27(4): 515-537.

Moyen, N. 2004. Investment-Cash Flow Sensitivities: Constrained versus Unconstrained Firms. *The Journal of Finance* 59: 2061-2092.

Myers, S. C. 1977. Determinants of corporate borrowing. *Journal of Financial Economics* 5(2):147-165.

Milgrom, P. and J. Roberts. 1992. *Economics, organization and management*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Miller, J. G. and T. E. Vollmann. 1985. The hidden factory. *Harvard Business Review*, 63 (5): 142-150.

Nohria, N. and Gulati, R. 1996. Is Slack Good or Bad for Innovation? *Academy of Management Journal* 39(5): 1245-1264.

Noreen, E. and Soderstrom, N. 1994. Are overhead costs strictly proportional to activity?: Evidence from hospital departments. *Journal of Accounting and Economics* 17(1): 255-278.

Noreen, E. 2016. *Capacity Constraints and Asymmetric Cost Behavior.* Working Paper. Temple University.

Penrose, E. 1959. *The Theory of the Growth of the Firm*. New York: Wiley.

Petersen, M. A. 2009. Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches. *The Review of Financial Studies* 22(1): 435-480.

Pfeffer, J. 1994. *Competitive advantage through people: Unleashing the power of the work force*. Boston, MA: Harvard Business School Press.

Pfeffer, J. and Salancik, G. R. 1978. *The External Control of Organizations: A Resource Dependence Perspective*. New York: Harper & Row.

Pindyck, R. 1988. Irreversible investment, capacity choice and the value of the firm. *The American Economic Review*. 78(5): 969-85.

Porter, M. 1980. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York, NY: The Free Press.

Qin, B., A. W. Mohan, and Y. F. Kuang. 2015. CEO overconfidence and cost stickiness. *Management Control & Accounting* 2015 (2): 26-32.

Richardson, P. R. and Gordon, J. R. 1980. Measuring Total Manufacturing Performance. *Sloan Management Review* 21(2): 47-58.

Richmond, W. B. and Seidmann, A. 1993. Software development outsourcing contract structure and business value. *Journal of Management Information Systems* 10(1): 57-72.

Seppä, T. 2000. *An Option-Pricing Approach to Risk and Return in Venture Capital*, Hseba, Helsinki.

Spence, M. 1977. Entry, Capacity, Investment, and Oligopolistic Pricing. *Bell Journal of Economics* 8(2): 534-544.

Spence, M. 1979. Investment Strategy and Growth in a New Market. *Bell Journal of Economics* 10(1): 1-19.

Spence, M. 1981. The Learning Curve and Competition. *Bell Journal of Economics* 12(1): 49-70.

Shust, E. and D. Weiss. 2014. Asymmetric cost behavior-sticky costs: expenses versus cash flows. *Journal of Management Accounting Research* 26 (2): 81-90.

Subramaniam, C. and Weidenmier, M. 2003. Additional Evidence on the Sticky Behavior of Costs. Working Paper. Texas Christian University.

Thompson, J. 1967. *Organizations in Action*. McGraw-Hill Companies, New York.

Trigeorgis, L. 1996. *Real Options: Managerial Flexibility and Strategy in Resource Allocation*, MIT Press, Cambridge, MA.

Trigeorgis, L., and Reuer, J. J. 2017. Real options theory in strategic management. *Strategic Management Journal* 38(1): 42-63.

Trigeorgis, L. and Mason, S. P. 1987. Valuing managerial flexibility. *Midland Corporate Finance Journal* 5(1): 14-21.

Wan, W. and Yiu, D. 2009. From Crisis to Opportunity: Environmental Jolt, Corporate Acquisitions, and Firm Performance. *Strategic Management Journal* 30(7): 791-801.

Weiss, D. 2010. Cost Behavior and Analysts' Earnings Forecasts. *The Accounting Review* 85(4): 1441-1471.

Wernerfelt, B. 1985. The Dynamics of Prices and Market Shares over the Product Life Cycle. *Management Science* 31(8): 928-939.

Yang, D. 2015. Mergers, CEO hubris, and Cost Stickiness. *Emerging Markets Finance and Trade* 51 (sup5): S46-S63.

Yasai-Ardekani, M. 1986. Structural Adaptations to Environments. *The Academy of Management Review* 11(1): 9-21.

Zahra, S. 1993. Environment, Corporate Entrepreneurship, and Financial Performance: A Taxonomic Approach. *Journal of Business Venturing* 8(4):319-340.