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The Effect of Intangible Resources on Selling, General, and Administrative Cost Behavior of Young and Established Firms

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Abstract

In this paper we investigate the effect of intangible resources on the relationship between activities and SG&A costs, and examine this effect on young and established firms. Prior research shows that costs are sticky in that costs decrease to a lesser extent following decrease in activities than they do increase following increase in activities of the same magnitude. We hypothesize that firms relying on intangible resources will exhibit stronger sticky cost behavior because (i) intangible resources are strategic resources and (ii) they possess unique properties that constrain managers' ability to selectively cut resources. Using a large sample of US firms, we show that costs are more sticky with increase in intangibles. We also show that the effect of intangibles on cost behavior is present only among young firms. These results are consistent with the notion that managers of young firms focus on building capacity, learning, and maintaining flexibilities whereas managers of established firms focus on efficiency.

Keywords: Sticky cost, intangible resources, capabilities, scalability, firm lifecycle stage.

Introduction

Prior research shows that the relationship between cost and demand-driven activities critically depends on adjustment costs and managers' deliberate decisions to adjust committed resources (Anderson, Banker, and Janakiraman 2003; Banker and Byzalov 2014). When demand increases, firms will generally increase committed resources in order to accommodate the new demand. Consequently, increase in demand will be followed by concurrent increase in committed resources and costs. In contrast, concurrent decrease in committed resources will accompany decrease in demand only when adjustment costs are sufficiently lower than expected benefits from such downward resource adjustments. Based on these observations, Anderson et al. (2003) predict and find that the percentage decrease in selling, general, and administrative expenses (SG&A costs) following decrease in activities is lower than the increase in SG&A costs associated with increase in activities of equal magnitude. Because SG&A costs generally respond less to decrease in activities than they do to increase in activities, Anderson et al. (2003) characterize the relationship as sticky cost behavior. Related research also shows that costs may be anti-sticky when incentives or behavioral biases induce managers to cut resources at a higher rate after decrease in activities than they would increase resources following increase in activities (Dierynck, Landsman, and Renders 2012; Kama and Weiss 2013). The theory of asymmetric cost behavior proposed by Banker and Byzalov (2014) identifies adjustment costs and managers' deliberate resource adjustment decisions as factors that underlie sticky, anti-sticky, and other cost behavior realizations.

In this study, we investigate how intangible resources affect the relationship between activities and SG&A costs, and how the effect differs between young and established firms. Firms' production technologies and competitive power are increasingly becoming reliant on intangible assets such as knowledge capital, brand name, corporate culture, and other resources across high-tech and other sectors (Itamy 1987; Jovanovic and Rosseau 2005). As a result, spending in intangible resources is nearly on par with the amount of investment in physical assets, with the level of investment in such assets (e.g., product design, brand building, employee training, etc.) reaching $3 trillion around the turn of the century (Nakamura 1999; Lev 2004; Mandel 2006; Corrado, Hulten, and Sichel 2009; Belo, Gala, Salomao, and Vitorino 2022). In addition, data on annual private sector investment show that total investment in intangibles grew more rapidly than investment in tangibles over the decade of the 1990s (Corrado et al., 2009). In light of increase in the importance of intangibles, we expect resource adjustment decisions to involve intangibles. Importantly, since adjustment cost of intangibles is generally more than adjustment costs of physical assets, we also expect more reliance in intangibles to be associated with more asymmetric cost behavior.[1]

Other features of intangibles are also likely to lead to higher adjustment costs. According to the resource based theory of the firm, sustainable competitive advantage can be attained by those firms endowed with rare, inimitable, and non-substitutable resources that are accumulated over time and that are generally not easily traded (Rumelt 1984; Wernerfelt 1984; Dierickx and Cool 1989; Barney 1991; Peteraf 1993). While these characteristics are also important for tangible resources, intangibles possess these properties to a greater extent (Teece 2000). In particular, properties that make strategic resources inimitable such as time compression diseconomies, causal ambiguity, and social complexity are more prevalent among intangible resources. These properties in turn make downward adjustment of committed resources distinctly difficult. For example, identifying resources that can be trimmed without adverse effect on the firm's strategic position will be difficult due to increased causal ambiguity. Due to time compression diseconomies, firms need to build and retain committed resources over a longer period of time. Because of social complexity and complementarities, cutting one resource will have effects on other assets. In short, managers will concurrently adjust committed resources when activities decrease to a lesser extent when intangibles are important for the firm's strategic position.

Furthermore, adjusting intangible resources down is more difficult than adjusting physical assets because intangible capital cannot be easily verified and liquidated or transferred (Hasan and Uddin 2020; Falato, Kadyrzhanova, Sim, and Steri 2022). Also, to the extent that adjusting intangible capital includes replacing highly trained employees (Brown, Fazzari, and Petersen, 2009), their adjustment costs will be greater. Altogether, the existing literature suggests that adjustment costs will be higher and that costs will be more asymmetric along with increase in intangible resources. However, the effect of all intangibles on cost behavior is largely

[1] For example, adjustment of knowledge capital in response to economic conditions represents about 10% of annual sales while adjustment of physical capital represents about 0.9% of annual sales (Belo et al. 2022).

unexplored. We fill this gap by examining how intangible resources influence asymmetric cost behavior using a novel proxy for reliance in intangible assets.

Even though intangible resources are expected to induce greater cost stickiness on average, this cost behavior is not likely to be prevalent throughout the firm's lifecycle. First, employees will master complex processes; and companies will partially codify tacit knowledge as they gain more experience. Hence, in later stages of their lifecycle, firms will be characterized by more learning through experience, process innovation, and efficiency (Utterback and Abernathy 1975; Jovanovic 1982; Nelson and Winter 1982). Greater focus on efficiency takes precedence over experimentation and building capabilities in later stages. In addition, due to greater scalability of intangibles (Haskel and Westlake 2018), this effect will be stronger as feasibility is reached later in the lifecycle for firms relying on such resources. Second, firms face less demand uncertainty later in the lifecycle. Generally, firms keep higher capacity when faced with uncertain demand to mitigate costs related to unusually high demand realizations (Banker, Byzalov, and Plehn-Dujowich 2014b). To the extent that firms face less demand uncertainty later in the lifecycle, adjustment costs will be lower and costs will be less sticky then.

We conduct our tests using a large sample of US firms over a 42-year period covering 1980-2021. We use three proxies to determine the importance of intangible resources to sample firms. Our primary proxy is constructed based on the idea that even though internally developed intangibles are not included in assets under US GAAP, the effect of such intangibles will be reflected in the current period's earnings (Penman 2009; Dichev 2017). We operationalize this intuition, and determine intangible asset contribution to earnings (IAC), as the residuals from regression of earnings on tangible net worth and change in tangible net worth. Following Villalonga (2004), we use Tobin's Q (Q) as the second proxy for intangible resources. Finally, because high-tech firms heavily rely on innovations and organizational capital (Brynjolfsson, Hitt, and Yang 2002), we use an indicator variable for high-tech firms to partition our sample into high-tech and non high-tech observations depending on whether firms are members of high-tech industries or not.[2]

Our results show that SG&A costs are more sticky with increase in intangible resources. Regardless of the proxy used, results show that more reliance on intangibles is associated with less response of SG&A costs to decrease in activities compared to their response to increase in activities of equal magnitude. These results suggest that unique properties of intangibles along with their increasing strategic importance constrain managers from concurrently adjusting such resources when activities decrease. We also find that the observed effect of intangibles on stickiness of SG&A costs decreases at later stages of firms' lifecycle. Specifically, we find that increase in SG&A cost stickiness with increase in intangibles is observed only among young firms. Though broad SG&A cost stickiness is present among established firms, intangible resources do not strengthen this broad cost behavior for those firms. These findings are consistent with the expectation that managers of young firms invest in resources to establish capabilities and maintain flexibilities under conditions of uncertainty. Later, managers' focus

[2] We classify companies into high-tech and low-tech industries based on three digit SIC codes following the approach in Francis and Schipper (1999) and Kwon and Yin (2015). Specifically, companies in computer, electronics, pharmaceutical, and telecommunications industries are among those included in the high-tech industries category.

shifts to more operational excellence and efficiency. Both sets of results are consistent with our predictions across alternative proxies for intangibles and across different empirical specifications.

Our study contributes to the literature in several ways. First, the study adds to the existing body of research that generally documents the existence of asymmetric cost behavior. The results here show that intangible resources incrementally influence cost behavior. Firms relying on more intangibles exhibit more SG&A cost stickiness because of relatively higher adjustment costs. We show these results using a novel proxy for intangible asset contribution that builds on the intuition that intangibles contribute to earnings even though the resources are not reflected as assets on the balance sheet (Penman 2009; Dichev 2017). To the best of our knowledge, we are the first to operationalize the role of intangibles in this way. Typically, studies that focus on intangibles estimate intangibles based on R&D and other expenses using an assumed depreciation rate (e.g., Lev, Radhakrishnan, and Zhang 2009; Peters and Taylor 2017; Hasan and Uddin 2020) or perpetual inventory method (e.g., Belo at al. 2022; Eisfeldt, Kim, and Papanikolaou 2022). Unlike these studies, our study focuses on the impact of all intangibles on earnings. Thus, in addition to contributing to the literature in cost behavior, we also contribute to the literature in intangibles by introducing a novel intangible asset proxy that reflects the effect of *all* intangibles on earnings.

We also show that the role of intangibles on cost behavior depends on lifecycle stage of firms. Managers of younger firms make investments to develop intangible resources that will later be scaled up once feasibility of innovation, organization capability, or marketing campaign is established. The second contribution of our study is thus to show that stronger cost asymmetry is observed among younger intangible intensive firms while this behavior is not observed among established firms. Understanding these distinctions is important for the broader research that focuses on earnings or cost management. Broadly speaking, earnings is *revenues-costs* (Banker, Byzalov, Fang, and Liang 2018). The results in our study show that US GAAP consistent earnings of young intangible intensive firms may be affected to a greater extent by cost stickiness due to intangible asset induced rigidities. Incorporating this distinction will lead to improvement in contracting efficiency or valuation when earnings are used as inputs for such purposes. With respect to cost management, the results will help managers implement sharper cost management efforts for young and established firms that rely on intangible resources.

Finally, we complement the findings in Venieris, Naoum, and Vlismas (2015) who examine the relationship between organization capital intangibles and cost in three respects. First, we use parsimonious and comprehensive proxies for all intangibles and show that resource adjustment costs are important for intangibles overall. Our primary proxy captures the effect of all intangibles in current earnings without making assumptions regarding capitalization and amortization of SG&A costs. Second, we provide new evidence that intangible assets induce stronger cost stickiness only for young firms. Third, we use the resource based theory of the firm framework and essential characteristics of intangibles from strategy and economics literatures to motivate our hypotheses and to interpret our results.

The remainder of this paper is organized as follows. Section 2 reviews related literature and discusses the basis of our hypotheses. Section 3 describes our sample and research design.

Sections 4 and 5 present our main results and results from additional tests, respectively. Finally, section 6 concludes the study.

Related Literature and Hypothesis Development

Cost management efforts in the short run decidedly depend on understanding how costs change in response to demand driven activities. As a result, management accounting textbooks emphasize on the importance of identifying relationships among activities, resources, and costs for implementation of effective cost management (see Horngren, Datar, and Rajan 2014; Mowen, Hansen, and Heitger 2016). These observations are premised on the idea that once relationships are formulated, managers can use the established relationships to concurrently match resources with the level of activities. Further, since costs are incurred to supply resources needed for activities (Cooper and Kaplan 1992), the relationships are essential for modeling cost behavior and eventually for managing costs. Using the linkages, managers are expected to align activities and resources by either increasing resources when activities increase or by decreasing resources when activities decrease. In this manner, resource levels will track activities, with predictable effect on costs. In effect, it is presumed that the response of costs to change in activities will broadly be symmetric such that the magnitude of increase in cost following a 1% increase in activities is expected to be the same as the magnitude of decrease in costs following a 1% decrease in activities.

Such a mechanistic relationship between activities (e.g., sales volume) and costs would hold if managers can adjust resources up or down on demand at negligible cost (Banker and Byzalov 2014). In reality, however, managers encounter substantial adjustment costs with respect to committed resources, particularly when activities decrease. For example, managers are less likely to implement swift downward physical asset adjustment along with activities because the sale price of such assets will be far less than the total purchase cost due to transaction costs, unrecoverable installation costs, removal costs, and asset specificity (Arrow 1968; Abel and Eberly 1996). Further, to the extent that the decrease in activities is induced by industry- or economy-wide shocks, recoverability will be even more limited since more firms with similar characteristics would attempt to sell assets at the same time (Shleifer and Vishny 1992).[3] Likewise, adjustment of labor involves search, selection, and training cost for new hires and severance package, lawsuit, and productivity losses related to employment terminations, especially for high skill labor (Ghaly, Dang, and Stathopoulos 2017; Golden, Mashruwala, and Pevzner 2020). Equally important, since capacity planning and resource commitment decisions are made for the long run, a gap between committed and used capacity is inevitable due to seasonality, capacity build up in anticipation of growth, or demand uncertainty (Snead, Stott, and Garcia 2010; Banker et al. 2014b). In a nutshell, adjustment costs cause activities and costs to be related in a rather complex fashion than the mechanistic way envisaged under the traditional view (Anderson et al. 2003; Banker and Byzalov 2014).

In their seminal paper, Anderson et al. (2003) highlight the centrality of adjustment costs and managers' resource adjustment decisions in shaping the relationship between activities and SG&A costs. They observe that managers do not typically respond to decrease in activities by

[3] Shleifer and Vishny (1992) argue that the gap between price and value in best use, illiquidity, is likely to be greater when the seller's distress is triggered by industry- or economy-wide shock because the highest valuation potential buyers are likely to be facing liquidity crisis at the same time as the seller.

immediately shrinking resources to the level just enough to support current activities because doing so will involve economically significant adjustment costs. Further, they argue that increase in activities can be accommodated only by increasing resources. On this premise, they predict the magnitude of the percentage increase in SG&A costs following increase in activities (increase in sales) to be higher than the absolute value of the percentage decrease in SG&A costs following the same level of decrease in activities. Using data from COMPUSTAT for US companies during 1979 -1998, they find that costs are, on average, less sensitive to sales decreases than they are to sales increases. Specifically, they document that whereas a 1% increase in sales is followed by a 0.55% increase in SG&A costs, a 1% decrease in sales is followed by a 0.35% decrease in SG&A costs. Based on these results, they conclude that costs respond to change in activities in an asymmetric manner rather than proportionately.

If adjustment costs influence managers' resource adjustment decisions, the observed asymmetric response of SG&A costs to activities is likely to be stronger with increase in proxies for adjustment costs. Anderson et al. (2003) test this hypothesis and find that SG&A costs are more sticky with increase in asset intensity. Golden et al. (2020) use a more refined proxy for labor adjustment costs and show that cost asymmetry is stronger with increase in reliance on skilled labor. Other studies that find support for the broad findings and hypotheses in Anderson et al. (2003) use country-level employment protection laws and within country legal protection of white-collar employees as proxies for labor adjustment costs (Dierynck et al. 2012; Banker, Byzalov, and Chen 2013). Collectively, these studies support the expectation that resource adjustment occurs after consideration of all adjustment costs.

Balakrishnan and Gruca (2008) examine the relationship between a hospital's various activities (direct patient, ancillary, and support services) and costs. They posit that hospital administrators will be reluctant to trim costs related to direct patient care activities, which they designate as core activities, because adjustment costs for those activities are relatively higher. For other activities, they expect administrators to be more willing to make concurrent adjustments when activities decrease because adjustment costs are relatively lower. They reason that hospital administrators will be less willing to cut resources that constitute core capabilities (direct patient care), but that they will be willing to cut resources related to outlying activities (support services). Consistent with these expectations, they find that operating costs are more sticky with respect to activities for core activities and that such cost behavior is not observed for support activities. Overall, their results support the view that managers are likely to consider both concurrent and future adjustment costs before adjusting capacity in response to current decrease in activities. Significantly, the evidence in Balakrishnan and Gruca (2008) also reinforces the observation that cost behavior is a manifestation of managers' deliberate resource adjustment decisions.

We build on these findings and expect the nature and importance of intangible resources to have an important implication on cost behavior. First, a firm's competitive power in the current economy crucially depends on intangible resources such as a particular technology, accumulated customer information, brand name, corporate culture, and other intangibles nearly all of which are invisible assets (Itamy 1987). As a result, intangible resources are found to be important in explaining firm value (Belo et al. 2022; Eisfeldt et al. 2022). Furthermore, Falato et al. (2022) provide evidence that US firms increase precautionary cash holdings with increase in intangibles mainly in order to exploit investment opportunities without facing costly financing. Since increase in intangibles diminishes debt capacity, managers increase precautionary cash holdings in order to sustain investment in such resources even during downturns.[4] Altogether, Itamy's (1987) observation and recent research in intangible resources suggest that intangibles are critical value drivers for US firms and that managers seek to sustain investment in those resources even during downturns.

Second, intangible resources are generally persistent due to lock-in cost and because they require longer periods to build under conditions of uncertainty. For instance, R&D projects in the biotechnology sector could take more than a decade even to produce revenue and then require large co-investments in marketing (Corrado and Hulten 2010). To the extent that investments in resources are made in the earlier phase to develop knowhow through experimentation where lack of vividness is prevalent, exit following temporary decline would involve forfeiting specialized resources and potential revenue (Ghemawat 1991). Ghemawat (1991) also argues that commitment to sustain projects is exacerbated due to managers' concern that lost ground cannot be recovered upon recovery of demand post-exit (i.e., lock-out cost is high). Notably, lock-out cost looms large in cases where resources are not traded in well-functioning markets. Since intangibles such as brand name or codified operating procedures are specialized assets, they are mainly untraded sticky factors that also require highly skilled labor (Ghemawat 1991; Brown et al. 2009; Haskel and Westlake 2018; Hasan and Uddin 2020; Falato et al. 2022).

Third, according to the resource-based theory of the firm, sustainable competitive advantage can be attained over time by those firms endowed with rare, inimitable, and non-substitutable resources (Rumelt 1984; Wernerfelt 1984; Dierickx and Cool 1989; Barney 1991; Amit and Schoemaker 1993; Peteraf 1993; Barney 1996). While these characteristics are also important for tangible resources, intangible resources possess these properties to a greater extent (Teece 2000). In particular, properties that make resources inimitable such as time compression diseconomies, causal ambiguity, and social complexity are more likely to be prevalent among intangible resources. Intangibles also involve experimentation with more time to develop, their value depends on use of other resources (complementarity), and relationships and information are critical for their successful development (Haskel and Westlake 2018). Since these resources are mainly people-embodied, repeated transactions with people or complex and specialized assets creates unspecifiable skills (Williamson 1979). As a result, managers will have difficulty in taking stock of skillsets possessed and those that could be irretrievably lost should they make adjustment decisions. In other words, even if managers are willing to adjust resources, their ability to make downward adjustment is more constrained because of the unique characteristics of strategic intangible resources. Cutting resources may lead to loss of strategic resources (due to causal ambiguity) or diminish the utility of remaining resources (due to complementarity).

Finally, innovations that result from intangible resources provide managers with valuable information even when they fail to produce marketable products, or the related resources could be easily deployed in alternative applications (Haskel and Westlake 2018). For these reasons, managers will not rush to cut intangible resources when activities decrease.

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[4] Increase in intangibles is associated with decrease in debt capacity because of limited verifiability and liquidation value of intangibles (Falato et al. 2022).

The above discussions indicate that intangibles have become significant strategic resources and that they possess distinct properties that increase adjustment costs. It is therefore likely that managers will be reluctant to concurrently adjust resources down with decrease in activities as intangibles become important for the firm. Thus, our first hypothesis, stated in the alternative, is shown below.

H1: On average, stickiness of SG&A costs is stronger with increase in intangible resources.

Banker and Byzalov (2014) argue that resource adjustment costs are the primitives that determine cost behavior. Their theory is that relationships between resource adjustment costs and cost behavior are context specific. In cases where adjustment costs are prohibitively high, managers will retain committed resources even when activities decrease. Costs will be fixed with respect to activities in such cases. In contrast, managers will concurrently adjust committed resources in response to decrease in activities if adjustment costs are negligible. Accordingly, costs will be fully variable with respect to activities. For most cases, where adjustment costs are neither negligible nor prohibitive, costs will be sticky on average. In short, fixed, variable, or sticky costs are not direct choices by managers but patterns that arise from managers' decisions to commit resources based on context-specific constraints (Banker and Byzalov 2014; Banker et al. 2018).

We expect the lifecycle stage in the development of intangible resources to be a key contextual factor that affects adjustment costs. Firms initially commit significant resources to discover intangibles and then focus on process efficiency as they learn from experience and perfect the routines through practice. In many ways, innovation and new ideas are rarely autonomous events that just happen, but rather are outcomes of a complex process of investment in technological expertise, product design, market development, and organizational capabilities which involve searching and then evolving towards more profitable ways of doing things (Nelson and Winter 2002; Corrado and Hulten 2010). Progressions through these stages generally follow broad patterns with implications on resource adjustment costs. At the earlier stages, firms (employees) lack the foresight to know the processes that work best in addition to being faced with demand uncertainty. Lacking in knowledge and certainty, they conduct ongoing experiments and attempt to learn through trial and error. Since the earlier phases in intangible development are generally characterized by uncertainty and lack of knowledge about what works, exit soon after short-term decrease of activities is contrary to the notion of the innovation process. Instead, the most successful avenue is to maintain dynamic capabilities which inevitably depend on maintaining resource flexibilities (Teece 1997). More broadly, earlier stages in organizations constitute fluid processes with loose and unsettled relationships between process elements and more slack (Utterback and Abernathy 1975). Hence, adjustment costs are likely to be higher in earlier phases.

Later in the lifecycle, managers are likely to establish a causal link between inputs (expenditures) and outputs. Importantly, cumulative learning, identification of successful routines, and high competence will emerge from trial-and-error and from sustained experiential learning processes (Alchian 1950; Nelson and Winter 2002). Furthermore, more experience is expected to create opportunities for partially codifying tacit knowledge and for routinization and perfection of complex activities and processes. Nelson and Winter (1982) also argue that firms tend to behave in the future according to routines they have employed in the past. Specifically, they observe that employees will be able to retrieve the appropriate actions from task memory as the correspondence between current challenges and earlier contexts and exposure increases. More experience also helps firms uncover their true efficiencies over time through a Bayesian learning process, increase in demand, product diffusion and increase in application of processes which in general induce a shift toward process innovation (Utterback and Abernathy 1975; Jovanovic 1982). This shift is likely to be more pronounced for intangibles because they are highly scalable once feasibility is reached (Haskel and Westlake 2018). Adjustment costs for intangibles are therefore expected to be lower in later phases.

Overall, the above discussions suggest that adjustment costs related to intangible resources are higher earlier in firms' lifecycle than they are later in the lifecycle. Often firms start with frontier technology and lower productivity due to limited built up knowledge and then they transition to more productivity as they become older, primarily because of learning (Atkeson and Kehoe 2005). As firms become more established, their organization capital and other intangibles will likely reach critical mass to become more scalable. Accordingly, we expect resource adjustment cost to be lower for established firms than they are for younger firms. Our second hypotheses, shown below, predict the effect of this shift on cost behavior.

H2a: Stickiness of SG&A costs is stronger with increase in intangible resources for younger firms.

H2b: Stickiness of SG&A costs is weaker with increase in intangible resources for established firms.

Sample Selection and Empirical Models

Sample Selection

We examine the relationship between the log change in SG&A costs (*ΔlnSGA)* and log change in sales (*ΔlnSALE)* for U.S. companies during 1980 – 2021 after controlling for asset intensity, employee intensity, and GDP growth as in Anderson et al. (2003) and other related studies (Li and Zheng 2017; Chen, Nasev, and Wu 2022). In addition, we require additional variables related to income and tangible net worth on COMPUSTAT in order to construct the primary independent variable that we use to assess the impact of intangibles on the relationship between costs and activities. Therefore, we start with 213,530 firm-year observations for the 1978 – 2021 period from COMPUSTAT annual research file with non-missing values of sales (SALE), selling, general, and administrative expenses (XSGA), operating income after depreciation (OIADP), interest expense (XINT), income taxes (TXT), total assets (AT), number of employees (EMP), current assets (ACT), net property, plant, and equipment (PPENT), other assets (AO), and total liabilities (LT). Variable names shown in parentheses are COMPUSTAT mnemonics.

We delete 26,287 observations with missing values of variables needed to construct IAC. Following Banker, Byzalov, Ciftci, and Mashruwala (2014a) and Li and Zheng (2017), we require valid observations for sales (SALE) for year t-2 through year t, and for selling, general, and administrative expenses (XSGA) for year t-1 to year t. In addition, we require that selling, general, and administrative expenses (XSGA) for a given year does not exceed sales (SALE) for the same period, as such relationships suggest unusually large commitment of resources (Anderson et al., 2003; Banker et al. 2014a). In addition, we require that sales (SALE) or selling, general, and administrative expenses (XSGA) in a given year is greater than 0 and that operating income is less than sales. As indicated in Table 1, these requirements reduce the number of observations by 38,760, leaving 148,483 observations. Also, following Anderson et al. (2003) and Chen et al. (2022), we control for employee intensity where employee intensity is defined as the log ratio of number of employees to sales. For that reason, we exclude 957 observations for which the number of employees (EMP) reported on COMPUSTAT is non-missing but where the reported number is zero (0). Finally, we discard observations for which the end-of-year stock price (PRCC_F) is below $1 (29,307). After we applied the above screening criteria, our final sample includes 118,219 observations.[5,6]

Table 1
Sample Selection

Description	Observations deleted	Observations remaining
Initial sample: firm year observations with non-missing values of financial and other variables on COMPUSTAT for 1978 – 2021.	-	213,530
Observations with missing values of lag variables needed for determination of IAC	(26,287)	187,243
Observations with missing values of $SALE_{t-2}$, $SALE_{t-1}$, and $XSGA_{t-1}$	(21,032)	166,211
Observations where $SALE_t$, $SALE_{t-1}$, $SALE_{t-2}$, $XSGA_t$, or $XSGA_{t-1}$ is less than or equal to 0	(7,337)	158,874
Observations where operating income is greater than sales *(SALE)*	(19)	158,855
Observations where SGA_t is greater than $SALE_t$ or $XSGA_{t-1}$ is greater than $SALE_{t-1}$	(10,372)	148,483
Observations where stock price at year end is less than $1	(29,307)	119,176
Observations where the number of employees is 0	(957)	118,219

Panel A of Table 2 summarizes the descriptive statistics of our sample. The mean (median) sales for our sample is $1,715 million ($195 million) while the mean (median) selling, general, and administrative expenses is $301 million ($36 million). For 36.1 percent of observations, sales in year t was less than the amount in year t-1. The mean (median) for our primary proxy for intangible asset contribution is 0.16 (0.097) while the mean and median of our

[5] This shows the number of observations for the full sample when we use our primary proxy for intangibles (IAC). The number of observations will be different when we use our second proxy for intangibles (*Q*).
[6] Following Anderson et al. (2003), we deflate all financial variables by CPI to control for inflation.

alternative proxy of intangible assets is 1.749 (1.356). On average, our sample firms' selling, general, and administrative expenses is 24.5% of sales. Conditional on decrease in sales, the mean *ΔlnSALE* is -0.145, and conditional on decrease in SG&A costs, the mean *ΔlnSGA* is -0.126.

We present t-tests and Wilcoxon sign rank tests for difference in means and medians for observations with high and low intangible asset contributions (*IAC*) in Panel B of Table 2.[7] Firms with high *IAC* generally generate higher amount of sales and spend more on selling, general, and administrative expenses. Specifically, the mean for high *IAC* firms exceeds that of low *IAC* observations by $631 million for sales and $164 million for selling, general, and administrative expenses. The mean of the ratio of selling, general, and administrative expenses to sales for high *IAC* firms is 25.7% while it is 25% for low *IAC* firms. Similarly, the means for both *ΔlnSALE* and *ΔlnSGA* are higher for high IAC firms (0.104 vs 0.036 for *ΔlnSALE* and 0.102 vs 0.046 for *ΔlnSGA*). Interestingly, the proportion of observations with decrease in sales from period t-1 to period t is higher for low IAC firms than it is for high IAC firms (42.4% vs 30.2%).

Table 2
Descriptive Statistics

Panel A: Descriptive Statistics – Full Sample

Variable	Mean	Median	Standard deviation	First Quartile	Third Quartile
SALE	1,715.125	194.566	7,254.246	49.581	812.921
SG&A	300.563	35.602	1,191.588	9.732	138.650
ΔlnSGA	0.066	0.047	0.216	-0.039	0.152
ΔlnSALE	0.064	0.047	0.238	-0.046	0.160
DEC	0.361	0.000	0.480	0.000	1.000
ATINT	-0.002	-0.076	0.680	-0.458	0.385
EMPINT	2.179	2.259	0.847	1.768	2.675
ΔGDP	0.055	0.057	0.026	0.041	0.064
FAGE	2.419	2.398	0.702	1.792	2.996
IAC	0.160	0.097	0.196	0.043	0.208
Q	1.749	1.356	1.251	1.035	1.965
HT	0.302	0.000	0.459	0.000	1.000
SG&A(%)	0.245	0.208	0.169	0.119	0.328
ΔlnSALE ($SALE_t < SALE_{t-1}$)	-0.145	-0.088	0.161	-0.190	-0.036
ΔlnSGA ($SG\&A_t < SG\&A_{t-1}$)	-0.126	-0.078	0.139	-0.163	-0.032

Panel B: Differences Between Means and Medians for Low and High Intangible Subsamples

Variable	Mean Low IAC (I)	Mean High IAC (II)	Median Low IAC (III)	Median High IAC (IV)	H_0: μ(I)=μ(II)	H_0: Med(III) = Med(IV)

[7] Low and high intangible subsamples are determined using rankings based on a proxy for intangible resources. Specifically, we first rank observations annually into quartiles using *IAC* or *Q*. Next, we designate observations in the first (fourth) quartile as low (high) intangible subsample.

SALE	1,189.705	1,820.668	128.045	239.999	-11.69***	-29.00***
SG&A	196.170	359.645	24.995	43.193	-16.91***	-30.14***

Table 2 (continued)

Variable	Mean Low IAC (I)	Mean High IAC (II)	Median Low IAC (III)	Median High IAC (IV)	H_0: μ(I) = μ(II)	H_0: Med(III) = Med(IV)
ΔlnSGA	0.046	0.102	0.032	0.068	-29.72***	-29.87***
ΔlnSALE	0.036	0.104	0.027	0.071	-32.76***	-34.88***
DEC	0.424	0.302	0.000	0.000	30.95***	30.70***
ATINT	0.038	-0.005	-0.048	-0.059	7.56***	4.99***
EMPINT	2.199	2.172	2.284	2.239	3.86***	6.10***
ΔGDP	0.055	0.055	0.055	0.057	-0.33	-0.44
FAGE	2.418	2.369	2.398	2.398	8.39***	8.29***
IAC	0.039	0.323	0.023	0.257	-172.68***	-198.24***
Q	1.539	2.173	1.194	1.678	-56.19***	-73.92***
HT	0.298	0.314	0.000	0.000	-4.35***	-4.35***
SG&A(%)	0.250	0.257	0.209	0.220	-4.59***	-7.11***

Notes: *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.
Variable definitions:
SALE= Net sales (SALE).
SG&A=Selling, general, and administrative expenses (XSGA).
ΔlnSALE=Log-change in sales (SALE) for a firm from year t-1 to year t.
ΔlnSGA=Log-change in selling, general, and administrative expenses (XSGA) from year t-1 to year t.
DEC=An indicator variable that takes 1 if sales (SALE) in year t is less than sales (SALE) in year t-1, 0 otherwise.
ATINT=Asset intensity defined as log-ratio of total assets (AT) to sales (SALE).
EMPINT=Employee intensity defined as the log of the number of employees (EMP) × 1,000 to sales (SALE).
ΔGDP=Growth in gross domestic product from year t-1 to year t.
FAGE = Log of firm age where firm age is defined as the number of years since the firm first appeared on COMPUSTAT.
IAC = Intangible asset contribution defined as the absolute value of residuals from regression of earnings on tangible net worth and change in tangible net worth. Income is defined as (OIADP - XINT - TXT), and tangible net worth is defined as (ACT + PPENT + AO - LT). All variables in the regressions are deflated by beginning of year total assets (AT_{t-1}).
Q = Tobin's Q defined as market value of equity (CSHO × PRCC_F) plus total assets (AT) minus book value of equity (CEQ) divided by total assets (AT).
HT = An indicator variable set to 1 for firms classified as high-tech firms, 0 otherwise. Classifications are determined using three digit SIC codes following Francis and Schipper (1999) and Kwon and Yin (2015).
SG&A(%) = SG&A expenses expressed as a percentage of sales.
Low and high intangible subsamples are determined using rankings based on a proxy for intangible resources. Specifically, we first rank observations annually into quartiles using IAC or Q. Next, we designate observations in the first (fourth) quartile as low (high) intangible subsample.

Consistent with the expectation that our second proxy for intangibles (*Q*) is related to the primary proxy for intangibles (*IAC*), the mean of *Q* for high *IAC* firms is higher than the mean of *Q* for low *IAC* firms. It also appears that high *IAC* firms are classified as high-tech firms more often than low *IAC* firms. The differences in means highlighted above are statistically significant, and the differences in medians of values for the two groups are consistent with the above results with respect of direction and statistical significance.

Our primary intangible asset contribution proxy is constructed based on the intuition that even though most internally developed intangible assets are critical strategic resources, they are not generally shown as assets under US GAAP. Regardless, their effect on income is reflected on the income statement through the superior earnings they help generate (Penman 2009, Dichev 2017). We presume that a company's income is primarily generated using tangible and intangible resources. Therefore, we attribute the portion of annual income that is not explained by tangible net worth to intangible resources of the firm. Specifically, we determine our primary proxy for intangible assets, intangible asset contribution (*IAC*), as the absolute value of residuals from the following regression by year and industry based on the Fama-French 12-industry classification.

$$INCOME_{i,t} = \alpha_0 + \alpha_1 TANGNW_{i,t-1} + \alpha_2 \Delta TANGNW_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where *INCOME* (*OIADP-XINT-TXT*) and *TNGNW (ACT+PPENT+AO-LT)* are income and tangible net worth, respectively. All of the variables are deflated by total assets at the end of year t-1 (AT_{t-1}).

Empirical Models

Our empirical strategy builds on the following standard model from Anderson et al. (2003).

$$\Delta lnSGA_{i,t} = \beta_0 + \beta_1 \Delta lnSALE_{i,t} + \beta_2 \Delta lnSALE_{i,t} DEC_{i,t} + u_{i,t} \qquad (2)$$

where *ΔlnSGA* is the log change in selling, general, and administrative expenses for firm i from year t-1 to year t; *ΔlnSALE* is the log change in sales for firm i from year *t-1* to year *t*; and *DEC* is an indicator variable set to 1 if sales in year *t* is less than sales in year *t-1*.[8] In this specification, β_1 shows the percentage change in SG&A costs in response to a 1% increase in sales while β_2 shows the change in SG&A costs when sales decreases relative to their increase following increase in sales. If SG&A costs decrease at a lower rate in response to sales decreases than they would increase in response to increase in sales, β_2 would be negative, and costs are deemed sticky.[9]

Costs, on average, exhibit sticky behavior because managers weigh savings from cutting committed resources in response to sales decline against the overall adjustment cost (Anderson et al. 2003; Banker and Byzalov 2014). Due to adjustment costs, costs are generally less responsive to activity decreases than they are to increases. However, costs are not expected to be uniformly sticky, anti-sticky, or symmetric. Rather, managers' assessment of relative savings vis-à-vis adjustment cost is likely to vary with contextual factors that constrain managers' adjustment decisions. For example, prior research shows that cost behavior systematically varies with asset intensity, employee intensity, and GDP growth (Anderson et al. 2003). In this study, we hypothesize that unique properties of intangible resources make adjustment costs on average higher. On that basis, we expand the baseline model to control for firm-specific and economywide factors and to include intangible resources as follows:

$$\Delta lnSGA_{i,t} = \beta_0 + \beta_1 \Delta lnSALE_{i,t} + (\beta_2 + \beta_3 INTNGBL_{i,t} + \beta_4 ATINT_{i,t} + \beta_5 EMPINT_{i,t} + \beta_6 \Delta GDP_{i,t}) \Delta lnSALE_{i,t} DEC_{i,t} + \beta_7 ATINT_{i,t} + \beta_8 EMPINT_{i,t} + \beta_9 \Delta GDP_{i,t}$$

[8] Since sales is affected by volume, change in sales generally captures change in activities. Hence, we will use change in sales and change in activities alternatively.

[9] The decrease in SG&A in response to a 1% decrease in sales is therefore given by $\beta_1+\beta_2$, and the hypothesis for cost stickiness conditional on $\beta_1>0$ is $\beta_2<0$ (Anderson et al. 2003).

$$+ \ \beta_{10} INTNGBL_{i,t} + \Sigma YEAR_t + \Sigma INDUSTRY_j + u_{i,t} \qquad (3)$$

$\Delta lnSGA$ and $\Delta lnSALE$ are as defined above. *ATINT*, *EMPINT*, ΔGDP are asset intensity, employee intensity, and GDP growth, respectively. *INTNGBL* is intangible, which we proxy using *IAC* or *Q*.[10] *YEAR* and *INDUSTRY* are indicators for year and Fama-French 12-industry classification, respectively. Hypothesis 1 predicts the coefficient of the interaction term between $\Delta lnSALE_{i,t}DEC_{i,t}$ and *INTNGBL* (β_3) to be negative and significant. To simplify interpretation of results, we also partition observations into high and low intangible subsamples and examine the coefficient of $\Delta lnSALE_{i,t}DEC_{i,t}$ in each subsample. To do so, we first rank observations annually into quartiles based on the intangible asset proxy (*IAC* or *Q*), and then we classify observations in the first (fourth) quartile as low (high) intangible subsample. Per hypothesis 1, the coefficient of $\Delta lnSALE_{i,t}DEC_{i,t}$ is expected to be negative and significant for the high intangible subsample.

We test hypothesis 2 using the model in equation 3 with a slight modification. First, we determine firm age as the number of years since the firm appeared on COMPUSTAT for the first time. Then, we partition the sample into young and established firm subsamples using the first and third quartiles of firm age as cut-off points.[11] We also complete tests by directly including log of firm age (*FAGE*) in the model, as shown in equation 4 below, instead of using it to partition the sample. In that case, we partition the sample into high and low intangible subsamples and include the log of age (*FAGE*) in the standard Anderson et al. (2003) model in the same way as the other variables (e.g., *ATINT* and *EMPINT*) are included.

$$\Delta lnSGA_{i,t} = \delta_0 + \delta_1 \Delta lnSALE_{i,t} + (\delta_2 + \delta_3 FAGE_{i,t} + \delta_4 ATINT_{i,t} + \delta_5 EMPINT_{i,t} + \delta_6 \Delta GDP_{i,t}) \Delta lnSALE_{i,t} DEC_{i,t} + \delta_7 ATINT_{i,t} + \delta_8 EMPINT_{i,t} + \delta_9 \Delta GDP_{i,t} + \delta_{10} FAGE_{i,t} + \Sigma YEAR_t + \Sigma INDUSTRY_j + \eta_{i,t} \qquad (4)$$

where *FAGE* is log of firm age, and firm age is defined as the number of years since the firm first appeared on COMPUSTAT. Other variables are as defined above.

Empirical Results

Intangible Resources and Sticky Cost Behavior

Panel A of Table 3 shows results for tests of hypothesis 1. In column 1 (Model 1), we examine the effect of *IAC* on cost behavior. Consistent with prior research, β_2 is negative and statistically significant (β_2 =-0.359, t-statistic = -15.34), confirming that costs on average are sticky.

Intangible resources require longer term commitments and impose higher adjustment costs due to their unique properties such as causal ambiguity, time compression diseconomies, commitments, non-tradability, and sunkenness (Dierickx and Cool 1989; Ghemawat 1991; Haskel and Westlake 2018; Hasan and Uddin 2020; Falato et al. 2022). Therefore, we predict in hypothesis 1 that costs become more sticky with increase in firms' reliance on intangible resources. Consistent with this prediction, column 1 of panel A of Table 3 shows that costs become more sticky with increase in *IAC*. Specifically, column 1 shows that β_3 is negative and significant at the 1% level (β_3 =-0.133, t-statistic = -2.69). Sustainable competitive advantage largely depends on the firm's resource endowments and intangible resources such as technology,

[10] Q is defined as market value of equity (*CSHO×PRCC_F*) plus total assets (*AT*) minus book value of equity (*CEQ*) divided by total assets (*AT*). Variable names in parentheses are COMPUSTAT mnemonics.
[11] The first (third) quartile of firm age for the sample is 6 (20) years.

customer information, brand name that can be sustained over time (Wernerfelt 1984; Rumelt 1984; Itamy 1987; Barney 1991; Peteraf 1993). This finding supports the expectation that strategic importance and unique properties of intangibles lead to more cost stickiness.

Table 3

The Effect of Intangible Assets on Sticky Cost Behavior

Panel A: Analysis for the Full Sample Using Alternative Proxies

Variable	Model 1	Model 2
INTERCEPT	0.010*	0.002
	(1.84)	(0.42)
ΔlnSALE	0.692***	0.684***
	(140.61)	(132.99)
ΔlnSALE × DEC	-0.359***	-0.342***
	(-15.34)	(-14.32)
ΔlnSALE × DEC× INTNGBL	-0.133***	-0.022***
	(-2.69)	(-3.33)
ΔlnSALE × DEC× ATINT	-0.113***	-0.113***
	(-12.29)	(-12.36)
ΔlnSALE × DEC× EMPINT	0.086***	0.084***
	(10.70)	(10.55)
ΔlnSALE × DEC× ΔGDP	0.833***	0.908***
	(4.42)	(4.82)
ATINT	0.008***	0.010***
	(7.81)	(8.73)
EMPINT	0.010***	0.010***
	(12.46)	(12.73)
ΔGDP	-0.114***	-0.112***
	(-2.90)	(-2.79)
INTNGBL	0.026***	0.006***
	(7.42)	(11.54)
Number of observations	118,219	113,385
Adj. R^2	0.49	0.49

Panel B: Subsample Analysis of Cost Behavior for Low and High Intangible Categories

Variable	Low IAC	High IAC	Low Q	High Q
INTERCEPT	0.049***	0.028**	0.009	0.055***
	(4.69)	(2.35)	(0.86)	(4.59)
ΔlnSALE	0.453***	0.687***	0.522***	0.597***
	(14.27)	(28.58)	(15.05)	(24.33)
ΔlnSALE × DEC	-0.066	-0.259***	-0.091	-0.232***
	(-1.22)	(-4.90)	(-1.62)	(-4.11)
ΔlnSALE × DEC × ATINT	-0.027	-0.064***	-0.041*	-0.057**
	(-1.16)	(-2.71)	(-1.88)	(-2.08)
ΔlnSALE × DEC × EMPINT	-0.050**	-0.037*	-0.073***	0.000
	(-2.53)	(-1.79)	(-3.84)	(0.01)
ΔlnSALE × DEC × ΔGDP	1.875***	1.090*	1.793***	0.879
	(3.18)	(1.88)	(2.87)	(1.49)

Table 3 (Continued)

Variable	Low IAC	High IAC	Low Q	High Q
ΔlnSALE × ATINT	-0.075***	-0.024**	-0.032**	-0.059***
	(-5.61)	(-2.34)	(-2.21)	(-4.73)
ΔlnSALE × EMPINT	0.105***	0.051***	0.094***	0.055***
	(9.60)	(6.66)	(9.02)	(6.14)
ΔlnSALE × ΔGDP	-0.559	-0.964***	-0.704	-0.518*
	(-1.41)	(-3.21)	(-1.58)	(-1.73)
ATINT	0.017***	0.018***	0.009***	0.024***
	(6.87)	(6.66)	(4.16)	(7.68)
EMPINT	-0.007***	-0.001	-0.003	-0.002
	(-3.80)	(-0.39)	(-1.55)	(-0.97)
ΔGDP	-0.151*	-0.042	0.013	-0.077
	(-1.88)	(-0.47)	(0.15)	(-0.85)
Number of observations	29,354	29,493	28,161	28,280
Adj. R^2	0.43	0.55	0.43	0.50

Notes: ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively. The numbers in parentheses are t-statistics based on standard errors clustered by firm. All regressions include indicators for year and industry.
The proxy for intangibles *(INTNGBL)* in Model 1 (Model 2) of Panel A is *IAC (Q)*.
Variable definitions:
ΔlnSALE=Log-change in sales (SALE) for a firm from year t-1 to year t.
ΔlnSGA=Log-change in selling, general, and administrative expenses (XSGA) from year t-1 to year t.
DEC=An indicator variable that takes 1 if sales (SALE) in year t is less than sales (SALE) in year t-1, 0 otherwise.
ATINT=Asset intensity defined as log-ratio of total assets (AT) to sales (SALE).
EMPINT= Employee intensity defined as the log of the number of employees (EMP) × 1,000 to sales (SALE).
ΔGDP= Growth in gross domestic product from year t-1 to year t.
INTNGBL = A proxy of intangible resources. The proxy is IAC or Q.
IAC = Intangible asset contribution defined as the absolute value of residuals from regression of earnings on tangible net worth and change in tangible net worth. Income is defined as (OIADP-XINT-TXT), and tangible net worth is defined as (ACT+PPENT+AO-LT). All variables in the regressions are deflated by beginning of year total assets (AT_{t-1}).
Q = Tobin's Q defined as market value of equity (CSHO × PRCC_F) plus total assets (AT) minus book value of equity (CEQ) divided by total assets (AT).
Low and high intangible subsamples are determined using rankings based on a proxy for intangible resources. Specifically, we first rank observations annually into quartiles using *IAC* or *Q*. Next, we designate observations in the first (fourth) quartile as low (high) intangible subsample.

Column 2 of panel A of Table 3 shows tests of hypothesis 1 using an alternative proxy for intangible resources (*Q*). Consistent with the findings based on the primary intangible resource proxy, the related coefficient is negative and significant (β_3 =-0.022, t-statistic = -3.33), showing a stronger impact of intangible resources on cost stickiness. The consistency of results under the two models provides confidence in our findings regarding the impact of intangibles on cost behavior.

We also examine the effect of intangibles on cost behavior after partitioning our sample into high intangible and low intangible subsamples based on the two proxies of intangibles. As a first step, we rank observations annually into quartiles using *IAC* or *Q* and designate the first (fourth) quartile as low (high) intangible subsample. A finding of significant cost stickiness for the high intangible subsample and lower cost stickiness or anti cost stickiness for the low intangible subsample would provide further evidence that intangibles increase cost stickiness. We show results from these tests in panel B of Table 3. Columns 1, 2, 3, and 4 show results for low *IAC*, high *IAC*, low *Q*, and high *Q* subsamples, respectively. For the low *IAC* subsample, β_2 is not significant (β_2 =-0.066 , t-statistic= -1.22), indicating that costs are not sticky for low *IAC* firms. We interpret this result as indication that managers can adjust resources in response to decrease in sales with less concern about consequent adjustment costs for low *IAC* firms.[12]

In contrast, β_2 is negative and statistically significant for high *IAC* firms (β_2 = -0.259, t-statistic =-4.90), suggesting greater reliance on intangibles increases cost stickiness. Results for tests using *Q* as a partitioning variable, presented in columns 3 and 4, are similar to the findings based on *IAC* as a partitioning variable. Specifically, β_2 for low intangible category is not significant (β_2 =-0.091, t- statistic =-1.62) whereas it is negative and significant at the 1% level for high intangible subsample (β_2 = -0.232, t-statistic = -4.11).

In summary, results in both panels of Table 3 support hypothesis 1 which predicts stronger cost stickiness, on average, with increase in intangible resources. The consistency of results from tests using alternative proxies and subsample tests gives confidence to the interpretation that these results are tied to unique properties and strategic importance of intangible resources.

Learning and Experience

In hypothesis 2, we predict stronger cost stickiness among young or less established firms. We classify observations with firm age of 6 years or less as young and those with firm age of 20 or more as established firms, using the first and third quartiles of firm age for the sample as cut-off points. Our firm age cut-off points are also consistent with classification of firms as young and established firms in prior research. Evans (1987a, 1987b) uses 6 years as a cut off point for young firms and 20 years as one of the cut-off points for older firms.

Table 4
The Effect of Intangibles on Sticky Cost Behavior among Young and Established Firms
Panel A: Subsample Analysis for Young and Established Firms

Variable	Young firms	Est. firms	Young firms	Est. firms
INTERCEPT	0.007	-0.007	-0.000	-0.012
	(0.77)	(-0.72)	(-0.04)	(-1.21)
ΔlnSALE	0.699***	0.615***	0.693***	0.611***
	(91.80)	(49.46)	(86.19)	(47.50)
ΔlnSALE × *DEC*	-0.289***	-0.357***	-0.346***	-0.309***
	(-6.29)	(-7.75)	(-7.13)	(-6.57)
ΔlnSALE × *DEC* × *INTNGBL*	-0.607***	0.196***	-0.021*	-0.003
	(-5.99)	(2.63)	(-1.87)	(-0.21)
ΔlnSALE × *DEC* × *ATINT*	-0.125***	-0.094***	-0.127***	-0.098***

[12] Managers can easily adjust resources because there are less ambiguities and because they can obtain off the shelf solutions that can pose limited friction when upward adjustment is needed in subsequent periods.

	(-7.51)	(-4.87)	(-7.40)	(-5.29)

Table 4 (Continued)

Variable	Young firms	Est. firms	Young firms	Est. firms
ΔlnSALE × DEC × EMPINT	0.080***	0.096***	0.075***	0.093***
	(5.00)	(6.05)	(4.50)	(6.05)
ΔlnSALE × DEC × ΔGDP	-0.015	1.461***	0.412	1.426***
	(-0.04)	(4.39)	(1.09)	(4.21)
ATINT	0.012***	0.003*	0.012***	0.005***
	(4.91)	(1.80)	(4.69)	(2.72)
EMPINT	0.010***	0.011***	0.010***	0.011***
	(5.88)	(7.81)	(5.65)	(7.96)
ΔGDP	-0.145**	-0.169***	-0.129*	-0.165***
	(-2.05)	(-2.82)	(-1.79)	(-2.66)
INTNGBL	0.043***	0.024***	0.005***	0.005***
	(5.02)	(4.75)	(5.45)	(5.67)
Number of observations	29,857	29,909	28,991	28,272
Adj. R^2	0.53	0.43	0.53	0.42

Panel B: Subsample Analysis for Low and High Intangible Firms

Variable	Low IAC	High IAC	Low Q	High Q
INTERCEPT	0.049***	0.032***	0.006	0.068***
	(4.41)	(2.59)	(0.55)	(5.70)
ΔlnSALE	0.590***	0.719***	0.647***	0.650***
	(53.15)	(97.70)	(53.99)	(74.36)
ΔlnSALE × DEC	-0.271***	-0.501***	-0.310***	-0.445***
	(-4.13)	(-7.33)	(-5.19)	(-5.58)
ΔlnSALE × DEC × FAGE	-0.002	0.065***	0.012	0.042*
	(-0.10)	(3.19)	(0.68)	(1.69)
ΔlnSALE × DEC × ATINT	-0.134***	-0.100***	-0.084***	-0.152***
	(-8.73)	(-5.25)	(-5.94)	(-6.74)
ΔlnSALE × DEC × EMPINT	0.099***	0.044**	0.057***	0.086***
	(6.87)	(2.52)	(4.16)	(4.83)
ΔlnSALE × DEC × ΔGDP	1.043***	0.290	0.975***	0.544
	(2.95)	(0.64)	(2.79)	(1.12)
ATINT	0.005**	0.013***	0.004*	0.011***
	(2.23)	(5.58)	(1.88)	(4.27)
EMPINT	0.009***	0.010***	0.010***	0.009***
	(5.67)	(6.41)	(6.25)	(5.65)
ΔGDP	-0.194**	-0.131	-0.031	-0.116
	(-2.46)	(-1.51)	(-0.37)	(-1.37)
FAGE	-0.031***	-0.021***	-0.024***	-0.028***
	(-13.94)	(-11.38)	(-11.07)	(-14.11)
Number of observations	29,354	29,493	28,161	28,280
Adj. R^2	0.43	0.55	0.43	0.50

Notes: ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively. The numbers in parentheses are t-statistics based on standard errors clustered by firm. All regressions include indicators for year and

industry.
Variable definitions:
ΔlnSALE=Log-change in sales (SALE) for a firm from year t-1 to year t.
ΔlnSGA=Log-change in selling, general, and administrative expenses (XSGA) from year t-1 to year t.
DEC=An indicator variable that takes 1 if sales (SALE) in year t is less than sales (SALE) in year t-1, 0 otherwise.
ATINT=Asset intensity defined as log-ratio of total assets (AT) to sales (SALE).
EMPINT= Employee intensity defined as the log of the number of employees (EMP) × 1,000 to sales (SALE).
ΔGDP=Change in gross domestic product from year t-1 to year t.
INTNGBL = A proxy of intangible resources. The proxy is IAC or Q.
IAC = Intangible asset contribution defined as the absolute value of residuals from regression of earnings on tangible net worth and change in tangible net worth. Income is defined as (OIADP - XINT - TXT), and tangible net worth is defined as (ACT + PPENT + AO - LT). All variables in the regressions are deflated by beginning of year total assets (AT_{t-1}).
Q = Tobin's Q defined as market value of equity (CSHO × PRCC_F) plus total assets (AT) minus book value of equity (CEQ) divided by total assets (AT).
FAGE = Log of firm age where firm age is defined as the number of years since the firm first appeared on COMPUSTAT.
Low and high intangible subsamples are determined using rankings based on a proxy for intangible resources. Specifically, we first rank observations annually into quartiles using IAC or Q. Next, we designate observations in the first (fourth) quartile as low (high) intangible subsample.

We present results for tests on the effect of firm age on cost behavior in Table 4. Panel A of Table 4 shows results for young and established firms separately, where the results in columns 1 and 2 are based on *IAC* and those in columns 3 and 4 are based on *Q*. Consistent with our expectations, cost stickiness becomes stronger with increase in intangibles for younger firms whether our proxy for intangibles is *IAC* (coefficient = -0.607, t-statistic = -5.99) or *Q* (coefficient = -0.021, t-statistic = -1.87). However, the coefficient is marginally significant when *Q* is used as a proxy for intangible resources. Also as expected, reliance on intangible resources does not lead to stronger cost stickiness for more established firms. The results, shown in columns 2 and 4, are consistent regardless of whether we use *IAC* (coefficient = 0.196, t-statistic = 2.63) or *Q* (coefficient = -0.003, t-statistic = -0.21) to proxy intangible resources.

In summary, while cost stickiness is prevalent among young firms that are reliant on intangibles, this phenomenon changes as firms become more established. This is consistent with the observation that entrepreneurs learn from experience and that efficiency becomes more important when operations become more routinized (Jovanovic 1982).

We also examine the impact of firm age after partitioning the sample into high and low intangible subsamples. For each subsample, we directly incorporate the log of firm age (*FAGE*) in the standard Anderson et al. (2003) model, as indicated in equation 4. Tests for this specification are presented in panel B of Table 4. The results in column 1 show that increase in firm age has no effect for low *IAC* firms (coefficient = -0.002, t-statistic = -0.10). In contrast, increase in firm age significantly weakens cost stickiness for high *IAC* firms (coefficient = 0.065, t-statistic = 3.19). Results for tests involving the alternative proxy for intangibles confirms these findings. Columns 3 and 4 show that firm age is not statistically related to cost stickiness for low intangible firms (coefficient = 0.012, t-statistic = 0.68) and that it is associated with weaker cost stickiness for high intangible firms (coefficient = 0.042, t-statistic = 1.69). However, the association for high intangibles subsample based on the second proxy (*Q*) is marginally significant. Overall, we interpret these results as further evidence that cost stickiness is weaker for established, high intangible firms.

Additional Tests and Robustness Checks

High-tech and Non High-tech Classification

We also test our hypothesis regarding the effect of intangibles on cost behavior using another proxy for intangibles. For these additional tests, we presume that knowledge-based or science intensive industries are characterized by higher intangible resources. On that basis, we classify observations into high-tech (HT) and non high-tech following the approaches in Francis and Schipper (1999) and Kwon and Lin (2015). Next, we use HT (an indicator variable) to proxy intangible assets. Untabulated results show that costs are more sticky for HT firms (β_3= -0.043, t-statistic = -2.85).[13] To the extent that high-tech firms are more reliant on intangible resources, our finding in this specification is further evidence that intangible resources contribute to stronger cost stickiness.

Expanded Model

We also use expanded Anderson et al. (2003) models that include interactions of our proxy for intangibles (*IAC* or *Q*) and control variables with $\Delta lnSALE_{i,t}$ in each regression. The results (not tabulated) are generally consistent with our findings that cost stickiness is stronger with increase in intangible resources. Specifically, costs are more sticky with increase in intangibles whether we use our primary proxy (coefficient = -0.288, t-statistic = -5.18) or alternative proxy (coefficient = -0.023, t-statistic = -2.94).[14]

Summary and Conclusion

Managers can generally accommodate increase in demand only if they increase committed resources. Therefore, they will be willing to increase committed resources when activities increase. In contrast, managers will be reluctant to concurrently decrease committed resources when activities decrease because of adjustment costs. For example, decrease in committed resources involves incurring costs for severance payments for laid-off workforce, disposal cost for physical assets, and penalties for canceled contracts. If demand recovers in later years, there will also be rehiring and training costs. Based on these observations, Anderson et al. (2003) predict and find that the rate of decrease in SG&A costs following decrease in sales is less than the rate of increase in SG&A costs following increase in sales of the same magnitude. Because the decrease in SG&A costs following decrease in sales, on average, is less than the increase in SG&A costs following increase in sales of the same magnitude, they characterize this relationship as sticky cost behavior. Banker and Byzalov (2014) offer an economic theory of asymmetric cost behavior that links adjustment costs and managers' decisions to cost behavior. We extend this line of research by examining whether intangible assets influence cost behavior

[13] Untabulated results also show that young HT firms exhibit stronger cost stickiness whereas established HT firms do not exhibit stronger cost stickiness.

[14] We also examine how *IAC* or *Q* impacts the response of SG&A costs to successive decrease in sales. Results (not tabulated) show that intangibles weaken the impact of successive decrease in sales on the response of SG&A costs.

and whether the effect of intangibles on cost behavior differs between young and established firms.

Using a large sample of US firms, we show that SG&A costs are more sticky with increase in intangible resources. Tests using different proxies for intangibles, different model specifications, and subsample analyses show that the results are consistent. Further examination of the effect of intangibles shows that while cost stickiness increases with intangibles for young firms, this effect is not observed for established firms. The first set of results is consistent with the expectation that properties prevalent among intangibles such as time compression diseconomies, social complexity, causal ambiguity, non-tradability along with their growing strategic importance increase adjustment costs. Results showing stronger cost stickiness among young firms suggest that firms initially build capacity through trial and error under conditions of uncertainty. Results for established firms are consistent with the view that managers' focus shifts to process efficiency as complex processes are routinized and knowledge is mostly codified at later stages.

Overall, we extend the literature by showing that intangible resources significantly influence the relationship between activities and SG&A costs due to their properties and their strategic importance. Further, we show that the effect exists mainly among young firms. We also extend the literature by introducing a novel and comprehensive proxy for intangible asset contribution.

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