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Unmasking Cost Stickiness in The Era of Digital Transformation

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Abstract

This study examines how digital transformation shapes cost behavior in Indonesia's consumer non-cyclical sector. Analyzing 326 firm-year observations (2021–2023) using Generalized Least Squares, the findings reveal cost anti-stickiness: firms cut expenses more aggressively during revenue declines. Digital transformation, however, increases cost stickiness due to high upfront investment, adjustment barriers, and strategic optimism, while labor productivity and working capital improve cost flexibility. The results highlight a paradox: digitalization constrains short-term flexibility but reinforces long-term resilience. Firms must therefore balance technology investments with operational agility to build adaptive cost structures in volatile environments.

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Introduction

"It is not the strongest species that survives, nor the most intelligent, but the most responsive to change."
— Charles Darwin, English Geologist/Naturalist

This philosophical perspective from Charles Darwin applies not only to the survival of humans and other living beings but also to modern global and business revolutions. A prominent example is technological advancement, especially digital transformation. Digital transformation is how organizations respond to environmental changes by reshaping value creation through digital technologies. These include mobile computing, social media, artificial intelligence (AI), cloud computing, big data analytics, and the Internet of Things (IoT) (Vial, 2019). As technology evolves, digital transformation has become a key driver of growth and competitiveness. It is now an imperative necessity—no longer just an opportunity—for managing the needs of a growing global population (Kraus et al., 2021). Digital transformation introduces new processes and mechanisms that fundamentally influence firm operations and value creation (Jardak & Hamad, 2022; Kutzner et al., 2018). It also fosters innovation by Wen et al. (2022) and enhances firm performance (Chouaibi et al., 2022). In business, digital transformation focuses on operational processes that incorporate changes in products, procedures, structures, and management concepts, positioning it as a holistic enterprise concept (Matt et al., 2015).

In the manufacturing industry, countries around the world are formulating strategies to enhance global competitiveness through digital transformation. In Indonesia, the Ministry of Communication and Informatics (Kominfo) has collaborated with several other ministries to promote digitalization, particularly in the manufacturing sector, through the Digital Indonesia Vision 2045. Aligned with this vision, the Ministry of Industry also supports the 4.0 digital transformation, as outlined in the "Making Indonesia 4.0" roadmap, which prioritizes advanced digital transformation across five key manufacturing sectors: food and beverages, textiles and apparel, automotive, chemicals, and electronics (Kementrian Perindustrian RI, 2018).

Despite the outlined potential and targets, digital transformation within Indonesia's manufacturing sector continues to face significant challenges. Although manufacturing contributed 20% to Indonesia's Gross Domestic Product (GDP) in 2021, the sector has shown sluggish growth due to productivity stagnation and limited innovation. From a digital maturity standpoint, the manufacturing sector remains in the "nascent" stage. Only 6% of Indonesia's manufacturing firms have adopted Industry 4.0 digital technologies such as robotics, cloud computing, big data analytics, AI, and 3D printing, while 64% remain in Industry 3.0. Productivity in this sector remains low as firms are reluctant to adopt digital technology due to high labor costs (Ministry of Communications and Informatics, 2023).

Undoubtedly, the implementation of digital technology is not a simple process. While digital transformation creates opportunities, it also brings challenges (Wen et al., 2022). Firms are often compelled to initiate small-scale changes before gradually transitioning from traditional manufacturing processes to digital systems (Zhou et al., 2018). One of the key challenges in initiating a sustainable digital transformation is cost management. In the early stages, cost stickiness tends to increase, exacerbated by agency costs, organizational shifts, and changes in business models that can introduce risk (Luo & Li, 2015; Zhao, 2015). Cost stickiness refers to the tendency for costs to increase more when business volume rises than they decrease when business volume falls (Anderson et al., 2003). Cost stickiness arises from resource asymmetry, shaped by adjustment costs, sales expectations, and managerial incentives within specific governance and institutional settings (Banker & Byzalov, 2014). Empirical evidence demonstrates cost stickiness among firms in ASEAN and Indonesia. Restuti et al. (2022b, 2022a, 2023) report its presence in ASEAN firms, while Lian et al. (2024) and Mariana et al. (2024) confirm similar patterns in Indonesian property, real estate, construction, and consumer goods sectors. Conversely, Restuti et al. (2025); Aninditiyah and Prabowo (2024) highlight instances of cost anti-stickiness, particularly during the COVID-19 pandemic. As firms slowly adopt digital transformation, internal control systems and risk management frameworks evolve, often requiring time to

stabilize. This creates opportunities for management to engage in opportunistic behavior, potentially worsening cost stickiness (D. Chen, 2022).

Even though digital transformation is inevitable, cost concerns make firms hesitant to move quickly. Many fear falling revenue by Haddud et al. (2017) and high labor costs (Ministry of Communications and Informatics, 2023). As labor costs rise, firms become more prone to cost stickiness when revenue or business drops. This may be due to contracts, labor laws, morale concerns, or training costs. For firms with large workforces and high labor costs, these expenses can be heavy burdens (Windyastuti, 2013).

Digital transformation also closely relates to operational performance. According to Tian et al. (2023), two dimensions of operational performance affected by digital transformation are labor productivity and working capital. Although digital transformation may lead to long-term gains, cost concerns remain prevalent. In terms of labor productivity, firms often struggle to quickly adjust labor costs in response to sales downturns (RSMUS, 2022). This phenomenon, referred to as "labor hoarding," occurs when firms retain their workforce during economic declines to avoid termination costs (Vella, 2018). From a working capital perspective, firms must maintain significant resources to support operations even when demand falls (Rakočević et al., 2014). These two dimensions, operational performance and cost stickiness, are closely interlinked and merit further investigation.

This study employs a text analysis method. By analyzing annual reports, this research provides a novel perspective on how digital transformation influences cost stickiness, diverging from prior studies that relied on surveys and interviews (Wu et al., 2020; Zhu & Luo, 2023). Text analysis is an appropriate approach, enabling the objective quantification of abstract concepts such as digital transformation through keyword frequency in annual reports—reliable, official sources of data. This approach ensures efficiency, consistency, and freedom from subjective perceptual bias, making it ideal for large-scale data analysis.

Previous studies mainly focused on factors affecting cost stickiness, such as corporate governance by Guo and Wang (2020); Kama and Weiss (2013), corporate strategy by Yu et al. (2019), stakeholder relations by Huang (2019), social responsibility by Fan et al. (2021), or earnings management (Jin, 2017). In contrast, this research examines how digital transformation and operational performance influence cost stickiness in non-cyclical consumer firms. It focuses on firms listed on the Indonesia Stock Exchange (IDX) from 2021 to 2023, including food and staples, beverages, agricultural products, tobacco, household products, and personal care products that align with the main manufacturing sectors outlined in the "Making Indonesia 4.0" roadmap. The main contribution of this study is to address a gap in the existing literature by exploring the impact of digital transformation on cost flexibility in dynamic business operations across these sectors.

Literature Review

Cost Stickiness

Traditional cost behavior models assume that variable costs change in direct proportion to changes in business volume. Theoretically, business volume reflects both the quantity of inputs and the effectiveness of the deployed resources. In practice, however, cost behavior often deviates from this assumption. Anderson et al. (2003) observed that when a firm's revenue increases, the associated increase in expenses tends to be greater than the reduction in expenses when revenue decreases. This phenomenon is referred to as “cost stickiness,” wherein cost increases accompanying business growth are typically greater than cost reductions during business decline.

Prior studies on cost stickiness assume resource asymmetry when predicting changes in sales and costs. Three primary factors determine cost stickiness: (1) adjustment costs, (2) expected future sales, and (3) managerial incentives interacting with governance, regulation, and ownership (Banker & Byzalov, 2014). Adjustment costs cause cost stickiness. These include spending to reduce idle resources and restore them

when business activity resumes. For example, a firm pays severance during layoffs in downturns but incurs further costs for recruiting and training when sales rebound. Layoffs can cost more than retaining employees during downturns, making firms reluctant to downsize. Downward adjustment costs, typically higher than upward adjustment costs, discourage firms from reducing resources during revenue declines, thereby causing cost stickiness (Anderson et al., 2003).

Second, cost stickiness may stem from optimistic expectations of future sales. Specifically, managers who expect sales to improve often believe that the firm's business volume will continue to grow. Therefore, when sales revenue declines, they tend to perceive it as a temporary condition and anticipate a near-term recovery. As a result, they may be reluctant to reduce resource investments even during business slowdowns. This optimistic outlook, in turn, leads to asymmetric cost changes in response to fluctuations in business volume, contributing to cost stickiness (Banker et al., 2010; Song et al., 2019).

Third, managerial incentive issues are frequently associated with agency problems. Specifically, in such cases, corporate executives entrusted with decision-making may be influenced by personal interests when allocating resources. As a result, in agency-related issues, managers often increase resource investments excessively when business volume rises and are reluctant to decrease them during declines, further contributing to cost stickiness (C. X. Chen et al., 2012).

Digital Transformation

Digital transformation is a strategic issue that firms of all forms and sizes must confront (Foss & Saebi, 2016). It is defined as the process by which organizations integrate digital technologies across all areas of their operations, fundamentally altering how value is delivered to customers (Service, 2025). Digital transformation has become an imperative, as firms that fail to adopt and implement it are unlikely to remain competitive in today's digital reality (Hess et al., 2016). Fundamentally, digital technologies, digital innovation, and digitalization are reshaping business processes, products, services, and relationships (Karimi & Walter, 2015). In response, firms must reinvent their operations and reshape employee mindsets to remain competitive (Hartl & Hess, 2017; Porter & Heppelmann, 2015).

Beyond addressing internal challenges related to efficiency and effectiveness Heavin and Power (2018), digital transformation can help firms transcend single-dimensional growth and achieve broader development in value creation (Gölzer & Fritzsche, 2017). Specifically, in the context of manufacturing firms, this broader development requires integrating diverse cultures, processes, resource structures, and digitalization-focused business strategies to create added value. To be effective, this strategy must be applied across all business activities, including development, production, quality control, and distribution (Albukhitan, 2020). Ultimately, the increased firm value resulting from digital transformation enhances a firm's competitive advantage (Matthyssens, 2019).

Digital transformation enables firms to collect large volumes of data and accurately identify diverse consumer needs using technologies such as the Internet of Things (IoT), blockchain, and cloud computing (Aversa et al., 2017). These data insights and consumer demands open new avenues for knowledge and networks, offering more opportunities for innovation and growth. Furthermore, digital transformation enhances operational efficiency, drives cost savings, and fosters innovation within firms (Zhang et al., 2021). In the long term, successful digital transformation can significantly improve a firm’s economic performance, including both revenue and profit (Westerman et al., 2014).

Operational Performance

Operational performance measures how efficiently and effectively a firm's internal processes are managed through collaboration (Claye, 2024). It covers productivity, quality, cost efficiency, flexibility, and speed, which are typically evaluated with key performance indicators (KPIs) to ensure alignment with business objectives (Buzinkay, 2024). Operational performance reflects both past achievements and future growth

potential (Tseng & Lee, 2014). As a core element of performance assessment, it is critical for identifying changes over time and developing strategies based on those insights (USAID USA, 2021).

Operational performance measurement is also used to monitor and evaluate the effectiveness and efficiency of a firm's strategic, operational, human resources, information systems, marketing, and financial objectives (Chvatalova & Koch, 2015). By establishing realistic and controllable targets for all stakeholders, each individual within the organization has clear guidance for working toward shared goals. In addition to improving communication, operational performance management also supports employee retention, job satisfaction, and productivity, ultimately contributing to improved operational efficiency. Firms focused on achieving optimal operational performance are better positioned to manage operations effectively and to make well-informed, timely decisions aligned with strategic goals (Franklin et al., 2019).

Key measures of operational performance include labor productivity and working capital productivity (Tian et al., 2023). These show how well a firm uses its resources. Labor is essential for decision-making and daily operations, promoting value creation and better corporate performance (Esho & Verhoef, 2020). Effective working capital management keeps business operations running smoothly. Having sufficient working capital enables firms to meet financial obligations and invest in growth opportunities (Fernando, 2024).

Hypotheses Development

The Impact of Digital Transformation on Cost Stickiness

The impact of digital transformation on cost stickiness can be examined from several perspectives. According to Banker and Byzalov (2014), the primary causes of cost stickiness include adjustment costs and optimistic managerial expectations. Specifically, adjustment costs refer to the expenses incur in firm's operational processes in response to changes in output or demand. However, firms may face challenges in reducing these costs during periods of declining activity, leading to cost stickiness. Among the factors driving adjustment costs is digital transformation.

Although digital transformation can offer numerous benefits, it may also increase firms' costs. Adjustment costs arising from digital transformation may include the development of new technological infrastructure, hiring of experts, and retraining of employees to operate digital systems. In some cases, firms may also need to overhaul their organizational structures and business processes, all of which require additional investment (Ahmed & Mohamed, 2024). On the other hand, Y. Chen and Xu (2023) argue that digital transformation can reduce adjustment costs and help prevent cost stickiness, particularly if firms focus more on "usage" rather than "ownership" of resources. In today's digital era, firms can meet their operational needs by sharing resources instead of owning them. Opting to "rent" rather than "buy" resources allows firms to minimize expenditures, thereby reducing adjustment costs and ultimately mitigating cost stickiness (H. Li et al., 2014). Additionally, digital transformation may help firms minimize unused production capacity, further lowering adjustment costs and reducing the potential for cost stickiness.

The second perspective focuses on optimistic managerial expectations. Optimistic outlooks held by firm managers can contribute to cost stickiness, as managers may delay cost reductions under the belief that sales will soon rebound (Zhong et al., 2020). They often view declines in business activity and layoffs of resources as temporary, which encourages behavior that fosters cost stickiness. This perspective also relates to digital transformation, particularly when managers invest in technology and digitalization with the expectation of substantial long-term benefits (Ahmed & Mohamed, 2024). Managers may assume that implementing digital technologies will result in future cost savings and increased revenues, without adequately considering the potential for cost stickiness if those outcomes are not realized.

Overly optimistic decision-making by management, without accounting for the risks of implementing digital transformation, may lead to cost stickiness. However, research by D. Chen (2022) offers a contrasting view. When firms undertake digital transformation, managers gain quicker access to market information and can

leverage technology to analyze and project expected benefits, sales, and profits. The implementation of digital tools enables firms to make more accurate decisions about resource investment, reduction, and retention, thereby making managerial expectations more realistic and measurable. Supporting this, Shahzad et al. (2024) found that digitalization in the manufacturing sector can influence cost stickiness by providing accurate data on production capacity and enabling real-time monitoring of market demand. This increased accuracy reduces uncertainty, thereby minimizing the occurrence of cost stickiness. Accordingly, the following hypothesis is proposed:
H1: *Digital transformation reduces cost stickiness*

The Impact of Operational Performance on Cost Stickiness
Referring to key factors in operational performance associated with cost stickiness as outlined by Tian et al. (2023), there is a strong relationship between labor productivity and working capital, with cost stickiness defined as asymmetric cost behavior in response to changes in activity levels, such as sales. Firms often struggle to reduce operational costs, such as labor expenses, when activity levels decline. To avoid cost stickiness and its long-term financial consequences, some firms choose to pass labor costs on to customers, automate certain operational processes, or outsource operational functions to external providers (RSMUS, 2022). The relationship between labor productivity and the resulting adjustment costs is complex; firms often face constraints in reducing productivity or adjusting work hours swiftly during downturns, which may lead to future cost stickiness (Dossche et al., 2021). Conversely, firms that retain high-quality labor during economic downturns may enhance their operational performance in the future, highlighting a strong connection between cost management practices and labor productivity (Kong et al., 2025). Accordingly, the following hypothesis is proposed:
H2a: *Labor productivity increases cost stickiness*

Working capital also influences cost stickiness from a different perspective. In certain situations, firms must maintain large resource bases to support operations despite declining demand, which can result in reduced liquidity and inefficiency in working capital utilization (Rakocevic et al., 2014). Poor working capital management may disrupt liquidity and hinder a firm's ability to reduce operating expenses during downturns (Napitulu & Ariefianto, 2024). For example, when working capital is tied up in inventory or accounts receivable, firms may struggle with cash flow management as sales decline (Re-Cap, 2024). Inflexible cost structures also contribute to cost stickiness, as firms must continue bearing operational expenses such as storage and labor even when demand drops. Conversely, firms with effective working capital management and flexible access to capital are better positioned to adjust costs during fluctuations in activity without liquidity constraints (Tuovila, 2024). Accordingly, the following hypothesis is proposed:
H2b: *Working capital increases cost stickiness*

Method

Data and Data Sources
The data used in this study are secondary financial and non-financial data from non-cyclical consumer sector firms listed on the Indonesia Stock Exchange (IDX). The primary data sources are firms' annual reports, obtained from the official IDX website and the respective corporate websites. These reports serve as the primary sources of data on digital transformation, operational performance, and cost stickiness.

Sample
The sample of this study is firms in the non-cyclical consumer sector listed on the Indonesia Stock Exchange (IDX). This study employs a purposive sampling technique based on the following criteria:
1. Firms in the non-cyclical consumer sector listed on the IDX period 2021–2023,
2. Firms that publish annual reports, and
3. Firms that disclose all data necessary for the research variables.

A detailed overview of the sample selection process is presented in Table 1:

Table 1. Sample Sampling Procedure

Description	Number of Observations
Total non-cyclical consumer firms listed on the IDX in 2021-2023 (131 firms * 3 years)	393
Less: Does not have complete annual reports for the years 2021-2023	(33)
Less: Does not have the variable data needed for 2021-2023	(34)
Total final sample used in the study	326

Source: Research Data (2025)

The 2021–2023 period is selected to avoid potential distortions in research results caused by the COVID-19 pandemic in 2020, which disrupted economic conditions and operational stability for most firms. This period also reflects the rapid digital transformation prompted by the pandemic and the introduction of various government policies supporting digitalization initiatives. Data from 2020 are also used solely for the calculation of cost stickiness, which is measured by the logarithmic ratio of cost in year t to cost in year t–1.

Variable Measurement

Digital transformation, the independent variable, is measured using a two-stage proxy. First, we reviewed the 2021–2023 annual reports of IDX-listed firms using NVIVO to identify digital transformation keywords disclosed in those reports. These keywords are summarized in the following table:

Table 2. Digitalization Keyword

No	Keywords Digitalization
1	*Artificial Intelligence / AI*
2	*Big Data*
3	*Block Chain*
4	*Cloud Computing*
5	Robot
6	*Digitalization*
7	*Digital Technology*
8	5G

Source: (Ahmed & Mohamed, 2024; Hui et al., 2024)

Second, the degree of digital transformation is measured based on NVIVO. NVIVO was employed due to its robust capabilities for extracting and calculating the frequencies of specified keywords embedded in corporate annual reports (Allsop et al., 2022). The resultant keyword count was subsequently operationalized as a quantitative proxy for measuring the level of digital transformation and serves as the basis for hypothesis testing.

The second independent variable, operational performance, is measured using two proxies: labor productivity and working capital (Ahmed & Mohamed, 2024). Labor productivity is calculated as revenue per employee, while working capital is measured as revenue divided by the difference between current assets and current liabilities.

In addition, this study includes a control variable, namely fixed asset intensity, measured as revenue divided by the average fixed asset value. Fixed asset intensity reflects the extent of a firm's investment in fixed assets, which typically generate high fixed costs. The higher a firm's asset intensity, the greater its investment in infrastructure and equipment. Because fixed costs are difficult to reduce during periods of declining sales, firms with high fixed asset intensity tend to exhibit stronger cost stickiness (Magheed, 2016). In this study, fixed asset intensity is used as a control variable to account for the impact of fixed cost structures associated

with asset investments on cost stickiness. This enables a more accurate analysis of the influence of digital transformation and operational performance on cost stickiness behavior.

The dependent variable, cost stickiness, is measured using the method of Anderson et al. (2003). In their model, cost stickiness is reflected in the relationship between changes in operating costs (dependent variable) and changes in revenue (independent variable), with an additional indicator variable for periods when revenue decreases. A log-log regression is used to allow better comparison across firms and to reduce heteroskedasticity. This study uses operating costs because they comprise a major share of non-cyclical consumer firms' costs. The general model used to calculate cost stickiness is as follows:

$$\Delta LnCost = \beta 0 + \beta 1 \Delta LnRev + \beta 2 Dec * \Delta LnRev + \varepsilon$$

The following is a summary table of the variables studied:

Table 3. Summary of Research Variables

Variable	Proxy	Measurement
Digital Transformation	Digital Transformation Practices	Using the NVIVO application to measure how much digital transformation keywords appear in firms' annual reports
Cost Stickiness	(Anderson et al., 2003) model	$\Delta LnCost = \beta 0 + \beta 1 \Delta LnRev + \beta 2 Dec * \Delta LnRev + \varepsilon$
Operational Performance	Labor Productivity	Ratio of $\frac{Revenue}{Number\ of\ Employee}$
	Working Capital	Ratio of $\frac{Revenue}{Average\ Working\ Capital}$
Control Variable	Fixed Asset Intensity	Ratio of $\frac{Revenue}{Average\ Fix\ Asset}$

Hypothesis Testing Model

The following is a hypothesis testing model:

$$\Delta LnCost = \beta 0 + \beta 1 \Delta LnRev + \beta 2 Dec * \Delta LnRev + \beta 3 DT * Dec * \Delta LnRev + \beta 4 LP * Dec * \Delta LnRev + \beta 5 WC * Dec * \Delta LnRev + \beta 6 FAI * Dec * \Delta LnRev + \beta 7 DT + \beta 8 LP + \beta 9 WC + \beta 10 FAI$$

Where:

DT = Digital Transformation
LP = Labor Productivity
WC = Working Capital
FAI = Fixed Asset Intensity
Rev = Revenue
Dec = Decrease in Revenue
Cost = Operational Cost

Result and Discussion

Descriptive Statistics

Table 4. Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
ΔLnCost	326	0.1132	0.4368	-2.3697	4.1348
ΔLnRev	326	0.1061	0.3859	-1.9878	2.7498
Dec	326	0.2783	0.4488	0	1
DT	326	98.84969	177.3981	0	1630
LP	326	3,630,000,000	8,260,000,000	0	60,100,000,000
WC	326	154.7431	2523.8050	-4136.7950	45300.9200
FAI	326	8.0679	21.2894	0	208.9477

Source: Research Data (2025)

Table 4 presents descriptive statistics for the main study variables. The mean ΔLnCost is 0.113, indicating an average 11.3% logarithmic change in operating costs. Similarly, mean ΔLnRev is 0.106, showing an average 10.6% logarithmic change in revenue. The ΔLnRev ranges from −1.988 to 2.750, highlighting some substantial revenue declines.

The Decrease variable is a dummy indicating whether a revenue decline occurred in a given period (0 = no decline, 1 = decline). Its mean is 0.278, meaning about 27.8% of observations experienced a revenue drop. The Digital Transformation (DT) variable, measured by the count of digital-related keywords in annual reports, averages 98.85 (range: 0–1,630), showing substantial variation in digitalization discourse. Labor Productivity (LP) averages IDR 3.63 billion (range: 0–IDR 60.1 billion), suggesting wide disparities across firms. Working Capital (WC) averages 154.74 (range: −4,136.80–45,300.92), indicating some firms faced deficits. Fixed Asset Intensity (FAI) averages 8.07 (range: 0–208.95), reflecting notable differences in fixed asset holdings.

Table 5 displays the correlation between variables. ΔLnCost is significantly positively correlated with ΔLnRev, indicating that as revenue increases, costs also rise. It is significantly negatively correlated with decrease, meaning costs decrease when revenues decline, consistent with cost stickiness. DT is positively and significantly correlated with WC, suggesting that higher digital transformation is associated with greater working capital. LP is positively correlated with FAI, indicating that increased fixed asset investment is associated with higher labor productivity. Other variables do not exhibit statistically significant linear relationships.

Table 5. Pairwise Correlation Matrix

	ΔLnCost	ΔLnRev	Decrease	DT	LP	WC	FAI
ΔLnCost	1						
ΔLnRev	0,7456***	1					
Dec	-0,4477***	-0,5385***	1				
TD	-0,0089	-0,0120	-0,0783	1			
LP	0,0661	0,0674	-0,0879	-0,0298	1		
WC	-0,0141	-0,0123	-0,0397	0,4960***	0,0045	1	
FAI	-0,0056	-0,0048	0,0131	0,0329	0,2495***	-0,0027	1

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level

Source: Research Data (2025)

Classic assumption testing has been conducted, with results indicating that the model passed the tests for autocorrelation and multicollinearity. However, it did not satisfy the tests for normality and heteroscedasticity. To address these limitations and better align with the characteristics of panel data, the analytical method uses Generalized Least Squares (GLS).

The use of GLS in panel data analysis has been shown to yield more efficient estimates than OLS, especially when the error terms are heteroskedastic and autocorrelated. Musau et al. (2015) emphasized that GLS effectively addresses such issues by producing more accurate and reliable parameter estimates in panel regression models. Furthermore, Bai et al. (2021) developed the Feasible GLS (FGLS) approach, which accounts for serial correlation and cross-sectional dependence in panel data, and demonstrated that it yields more efficient estimates than OLS under such conditions.

Regression Analysis

Table 6. Regression Analysis Result

Δ*LnCost*	Coefficient	P>|Z|
ΔLnRev ($\beta_{1)}$)	0,8476	0,000
Dec*ΔLnRev ($\beta_{2)}$)	0,0821	0,000
DT*Dec*ΔLnRev ($\beta_{3)}$)	-0,0022	0,000
LP*Dec*ΔLnRev ($\beta_{4)}$)	0,0000	0,048
WC*Dec*ΔLnRev ($\beta_{5)}$)	0,0002	0,008
FAI*Dec*ΔLnRev ($\beta_{6)}$)	0,0051	0,002
DT ($\beta_{7)}$)	0,0000	0,004
LP ($\beta_{8)}$)	0,0000	0,039
WC ($\beta_{9)}$)	0,0000	0,703
FAI ($\beta_{10)}$)	0,0000	0,688
_cons ($\beta_{0)}$)	0,0241	0,000

Source: Research Data (2025)

Table 6 presents the results, indicating that the variable ΔLnRev (β_1), representing the change in the natural logarithm of revenue, is statistically significant and positively associated. Likewise, the interaction variable Decrease*ΔLnRev (β_2), which measures the effect of revenue decreases on costs, also shows statistical significance with a positive direction. These findings suggest that the observed firms exhibit cost anti-stickiness behavior, rather than cost stickiness. Cost anti-stickiness occurs when operational costs decrease more significantly when revenue declines than when it rises.

The interaction term DT*Dec*ΔLnRev (β_3), where DT indicates digital transformation, shows a statistically significant negative coefficient. This implies that digital transformation reduces cost anti-stickiness, thereby increasing cost stickiness (costs decrease less when revenue falls). Hence, hypothesis 1 (H1), which posits that digital transformation reduces cost stickiness, is not supported. The variable LP*Dec*ΔLnRev (β_4), where LP represents labor productivity, is also significant and positively signed. This indicates that higher labor productivity increases cost anti-stickiness, meaning costs decrease more when revenue decrease. Similarly, the variable WC*Dec*ΔLnRev (β_5), where WC stands for working capital, is significant and positively associated. This means that an increase in working capital leads to cost anti-stickiness—meaning it reduces cost stickiness (when costs decrease more readily as revenues fall). Thus, hypothesis 2b, which asserts that working capital increases cost stickiness, is not supported. The control variable FAI*Dec*ΔLnRev (β_6), where FAI represents fixed asset intensity (the proportion of a firm's assets tied up in fixed assets like property, plant, and equipment), is also statistically significant and positively signed. This suggests that firms with greater fixed asset intensity are more responsive in cutting costs when revenue declines. High fixed asset holdings may increase pressure on operational efficiency because depreciation costs remain even when production is low. As a result, firms are likely to reduce other variable or operational costs more quickly to compensate for the lack of flexibility in fixed asset costs. are likely to reduce other variable or operational costs more rapidly to offset the inflexibility of fixed asset burdens.

Discussion

The cost anti-stickiness behavior (when firms reduce costs more quickly as revenues fall, rather than maintaining prior spending levels) identified in this study reflects a tendency for firms to respond more quickly to revenue declines by cutting costs. Such responses may represent managerial strategies that are adaptive to financial performance pressures or economic uncertainty, prompting tighter operational efficiency. These findings are consistent with Hassanein and Younis (2020), who observed cost anti-stickiness in the UK chemical industry during and after economic crises. Thus, the findings suggest that not all firms resist cost reductions; rather, many proactively adjust costs downward in response to revenue contraction.

In contrast, the results for hypothesis 1 indicate a negative relationship, suggesting that digital transformation reduces cost anti-stickiness (i.e., increases cost stickiness). While digital transformation is often regarded as enhancing cost efficiency and flexibility, the findings reveal that in certain contexts, it may reinforce cost stickiness. This could be attributed to the significant and complex upfront investments required for digital transformation, including the development of new technological infrastructure, integration of information systems, and procurement of software and hardware, all of which are not easily reduced when revenue declines. The finding can also be explained by the role of digital transformation in enhancing managerial flexibility and information processing capacity. Digital tools, such as advanced analytics, enterprise systems, and integrated platforms, enable managers to obtain more accurate and timely insight into market trends, customer behavior, and resource utilization. With this improved visibility, managers are less compelled to pursue drastic cost-cutting measures, as they can anticipate demand recovery more effectively and allocate resources with greater precision. Furthermore, Ahmed and Mohamed (2024) note that digital transformation introduces additional adjustment costs, such as hiring specialized IT personnel and retraining existing staff to operate new systems. These costs tend to be "sticky," as they are not readily eliminated in the short term.

Additionally, optimistic managerial expectations regarding the long-term benefits of digital transformation may further contribute to cost stickiness (Zhong et al., 2020). Managers who believe in future returns from digital investments are likely to maintain related expenditures during revenue declines, anticipating technological improvements over time. Thus, the impact of digital transformation on cost structure flexibility is context-dependent, shaped by the stage of technology adoption and managerial perceptions of risk and benefit. In practice, this suggests that digitalized firms are better positioned to retain critical resources—particularly human capital and technological capabilities—during downturns, thereby supporting long-term competitiveness. Such strategic retention prevents under-capacity when demand rebounds and ensures business continuity and innovation momentum. Therefore, digital transformation acts as both a driver of operational efficiency and a stabilizing mechanism in cost behavior, enabling managers to balance short-term efficiency with long-term resilience.

With regard to hypothesis 2a, the positive relationship indicates that labor productivity increases cost anti-stickiness (i.e., reduces cost stickiness, where cost stickiness means costs do not decrease proportionally when revenues fall). Firms with higher labor productivity are better positioned to adjust their cost structures during downturns. This may be due to more efficient or flexible work systems (Y. Li et al., 2024). High labor productivity also reflects efficient utilization of human capital—meaning the productive use of employees' skills and time—enabling firms to operate without excess capacity when revenues decline. Moreover, retaining high-quality labor can enhance future operational performance (Kong et al., 2025). These findings suggest a strong link between cost management and labor productivity, enabling firms to adjust costs more effectively and reduce stickiness.

More productive employees enable firms to sustain output with fewer resources, prompting managers to reduce labor or operating costs more aggressively when sales decline. While this behavior improves short-term efficiency and protects cash flows, it may also erode organizational capacity, diminish employee morale, and compromise preparedness for a future rebound in demand. To address this trade-off, managers

should complement productivity gains with flexible compensation schemes and retention of critical talent, and use scenario-based planning to balance immediate efficiency with long-term resilience (Anderson et al., 2003; Argilés-Bosch et al., 2017; Banker & Byzalov, 2014).

Lastly, hypothesis 2b also shows a positive direction, indicating that working capital increases cost anti-stickiness (i.e., reduces cost stickiness). Firms with greater working capital tend to avoid excessive fixed cost retention during revenue downturns. Adequate working capital reflects high liquidity and financial flexibility, allowing for cost adjustments without jeopardizing operational stability. Napitulu and Ariefianto (2024) emphasized that poor working capital management can impair liquidity and hinder cost adjustments during periods of declining activity. Supporting this, the present findings show that firms with high working capital are better equipped with liquidity and operational flexibility to adjust costs efficiently. Sufficient working capital provides room for variable cost adjustments and prevents resource waste, enabling firms to maintain short-term operational continuity without overly rigid cost structures.

The finding that higher working capital increases cost anti-stickiness highlights the role of financial flexibility in shaping cost behavior. Firms with abundant working capital often perceive greater room to protect liquidity, which encourages managers to reduce operating costs more aggressively during sales downturns. From a managerial standpoint, such behavior preserves short-term cash flow and strengthens financial stability, yet it may also lead to underinvestment in critical resources and limit the firm's ability to capture demand recovery. To mitigate these risks, managers should complement working capital management with strategic resource retention and scenario planning, ensuring that cost adjustments are calibrated to maintain both efficiency and long-term competitiveness resilience (Anderson et al., 2003; Banker & Byzalov, 2014).

Industry characteristics may also influence the presence of cost stickiness. This study focuses on the consumer non-cyclical sector, which has traits that may explain the observed cost anti-stickiness. Generally, this sector is considered resilient to economic fluctuations, as it provides essential goods that remain in demand even during economic downturns (J. Chen, 2021). However, due to stable demand, firms in this sector often adopt efficient, flexible cost structures from the outset to sustain competitive margins. When revenues fall, these firms are typically more responsive in cutting operational costs to preserve profitability. This may result from market efficiency pressures and investor expectations for financial stability. Moreover, the relative ease of outsourcing and automation in this sector enables firms to adjust costs swiftly in response to changes in revenue. These industry-specific features help explain the cost anti-stickiness observed, in which cost reductions are more substantial and timelier during revenue declines.

The finding that digital transformation reduces cost stickiness, while labor productivity and working capital increase it, reveals patterns that diverge from initial expectations and highlight the contextual nature of cost behavior. Beyond adjustment cost and managerial expectation, firm-level capabilities and financial conditions appear to shape asymmetric cost responses in different ways. These results underscore the need to integrate digitalization, labor efficiency, and liquidity into cost behavior theory and point to boundary conditions-such as industry dynamics and governance-that may explain variation across settings. In this way, the study contributes to a more nuanced understanding of cost asymmetry beyond conventional assumptions of uniformity and stability.

Conclusions and Recommendations

This study examines cost stickiness by analyzing how digital transformation and operational performance influence a firm's ability to adjust its cost structure during periods of declining activity. The key finding is the presence of cost anti-stickiness, where costs decrease more than expected during downturns—contrary to traditional cost stickiness.

Digital transformation is found to reduce cost anti-stickiness. Although digital transformation is widely regarded as a driver of efficiency and cost flexibility, this study shows that under certain conditions, digitalization may instead reinforce cost stickiness. This can be attributed to substantial initial investments, long-term adjustment costs, and managerial optimism regarding the long-term benefits of technological investments, which encourage firms to retain resources even during revenue downturns. Labor productivity is also shown to increase cost anti-stickiness, as work efficiency and system flexibility allow firms to adjust cost structures more rapidly. Additionally, greater working capital increases cost anti-stickiness by enabling firms to manage costs adaptively without maintaining unnecessary operational capacity.

These findings highlight that firms need operational efficiency, sufficient liquidity, and effective planning when they adopt digital technology. This approach helps create a cost structure that reacts to changing market conditions. By adding digital transformation as a central variable, this study offers a more contextual understanding of how digitalization shapes cost flexibility in modern firms. The results can help managers spot hidden risks of digital implementation, especially those tied to cost rigidity.

Although this study finds that digital transformation is associated with increased cost stickiness, this does not inherently imply negative outcomes. Instead, it reflects a natural shift in cost behavior that accompanies transformation. Cost stickiness during the digital transition phase is a normal adaptive response. As new technologies are adopted and workflows reengineered, initial inefficiencies and higher costs may occur, with fixed costs that do not immediately adjust to changes in revenue or production. Rather than viewing cost stickiness as a barrier, managers should recognize it as an inevitable signpost for recalibrating cost management and optimization strategies.

To maximize digital transformation's long-term benefits, firms should keep raising labor productivity and manage working capital efficiently. This allows digital change to fuel innovation, boost efficiency, and help maintain a healthy, adaptable cost structure. This study also serves as a reference for researchers seeking to explore digital transformation, performance, and cost behavior in modern industries.

This study contributes to cost behavior research by showing that digital transformation, labor productivity, and working capital shape cost anti-stickiness in distinct ways. Theoretically, the findings suggest that cost asymmetry depends on technological, operational, and financial context, challenging models that assume uniform drivers. Practically, managers should use digital transformation to stabilize cost adjustments and exercise caution before making cost cuts driven by higher productivity and liquidity. Balancing short-term savings with long-term organizational capacity and competitiveness is essential.

However, this study has several limitations. First, the use of NVIVO software to analyze the frequency of digital transformation-related terms in annual reports has inherent constraints in detecting the complex variety of digitalization terminology. Additionally, keyword frequency in annual reports does not always accurately reflect the actual level of digital transformation within a firm. High keyword counts may reflect corporate communication strategies rather than measurable implementation, potentially biasing perceptions of the extent of digitalization. Second, although digital transformation and labor productivity have passed statistical tests for multicollinearity, these variables may still influence each other, and the potential for interaction or mediation effects cannot be ruled out entirely. Therefore, future studies are encouraged to combine textual analysis with qualitative data or internal performance metrics and adopt more sophisticated modeling approaches, such as mediation or interaction effect models, to better understand the complex relationships among the studied variables.

Future studies can take several approaches. Given NVIVO's limitations and the sparse digital transformation disclosure in reports, subsequent research could include interviews or surveys with executives and managers. This would give better insight into digital actions and provide useful qualitative information. Methodological upgrades aside, research could also widen the scope by comparing industries, since digital

change moves at different speeds across sectors. Cross-national work is also needed to contrast advanced and emerging digital environments. Long-term studies would help, since digital transformation is gradual and costs vary by stage. Early phases often need more investment, while later phases focus on training and maintenance. Future research should also consider new technologies like blockchain, artificial intelligence, and advanced analytics, not just existing digital tools.

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