

# Asymmetric Cost Behavior Across Life Cycle Stages

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## Abstract

The traditional model of cost behavior has been criticized for its symmetric cost behavior assumption. A new model has been proposed assuming that costs respond differently to upward and downward activity changes. The main objectives of this paper are to investigate the existence, degree, and nature of asymmetric cost behavior (ACB) phenomenon and examine how the organization life cycle (OLC) affects this phenomenon in the context of Egypt. The current study achieves these objectives by employing multiple regression to explore the behavior of cost of goods sold (COGS), selling, general and administrative cost (SGA), and total cost (TC) for 1577 firm-year observations (99 manufacturing firms) during the period from 2000 to 2019. The results demonstrate that all three cost proxies (COGS, SGA, and TC) are sticky with the highest degree of stickiness to TC. In addition, OLC is a conditional factor that affects how costs behave in response to change in activity level. Consistent with theoretical propositions, both COGS and TC exhibit anti-stickiness behavior for firms in the introduction stage and stickiness behavior for firms in the growth, mature, and shakeout/decline stages. However, SGA is only sticky for firms in the mature stage.

However, the hypotheses related to asymmetric behavior of SGA were rejected for firms in the introduction, growth, and shakeout/decline stages.

**Keywords:** Asymmetric cost behavior, COGS, SGA, TC, Organization life cycle, Egypt

## 1. Introduction

Cost behavior is considered one of the most significant analyses of the decision-making process. The traditional model of cost behavior assumes that costs change symmetrically to changes in activity level. However, numerous cost behavior studies provide robust empirical evidence of asymmetric cost behavior (ACB); specifically, costs behave differently to upward and downward changes in cost driver level. Anderson, Banker, & Janakiraman (2003; ABJ hereafter) provide empirical evidence that selling, general and administrative cost (SGA) decreases less when revenues decrease than they increase when revenues increase by an equivalent percentage. They labeled this new phenomenon as "cost stickiness". Costs are sticky if they decrease less as output level falls than they increase as output level rises by an equivalent percentage (Balakrishnan, Labro, & Soderstrom, 2014; Banker & Byzalov, 2014; Yao, 2018). Other studies prove that costs are anti-sticky in that they decrease more as output level falls than they increase as output level rises by an equivalent percentage (Kama & Weiss, 2013; Weiss, 2010). Both scenarios represent the forms of ACB.

Given that costs behave asymmetrically relying on the traditional cost behavior model causes information distortion even when employing more advanced accounting practices. For example, Noreen (1991) shows that activity-based costing is relevant to allocate costs only when costs change in direct proportion to activity level. ACB model represents a strategic behavior model (Balakrishnan & Gruca, 2008). It reflects both the effect of change in activity level during the current period and the managerial assessment of the past and expected changes in demand.

Literature provides several factors affecting the nature and degree of ACB including, but not limited to, the existence of adjustments costs (Cannon, 2014; Yasukata, 2011), economic growth (Ibrahim, 2015), optimism of managers about expected demand (Yao, 2018), Empire-building incentive (Chen, Lu, & Sougiannis, 2012), the incentive to meet earning targets (Kama & Weiss, 2013), and corporate governance (Ibrahim & Ezat, 2017). On this ground, ACB occurs due to several internal and external determining factors that could be expressed by the organization life cycle (OLC) stages. OLC reflects an organization's development resulting from changes in both internal and external environments (Vorst & Yohn, 2018).

According to the life cycle theory, organizations are just like living organisms in that they go through several anticipated configuration phases of development (Kiani, Aghaee, & Etemadi, 2018; Miller & Friesen, 1984). In this way, the life cycle framework provides managers with guidelines and directions, helping them in decision-making.

One of the most popular OLC models is to group firms, depending on their environmental context, strategy, structure, and decision-making methods, into five primary stages: introduction, growth, maturity, shakeout, and decline (Miller & Friesen, 1984). While firms at

the same stage have common characteristics, each stage has considerably different contexts that discriminate it from other stages (Su, Baird, & Schoch, 2015; Vorst & Yohn, 2018). These persistent differences between organizations in different life cycle stages propose that the nature and degree of asymmetric cost behavior can be modeled as a function of an OLC. The current study extends cost behavior literature by investigating the undiscovered relationship between OLC and ACB.

The contribution of this study is threefold: First, prior literature demonstrates that asymmetric cost behavior is affected by several factors such as firm size (Dalla Via & Perego, 2014), ability to access the capital market (Cheng, Jiang, & Zeng, 2018), managerial optimism (ABJ, 2003), and corporate governance (Ibrahim & Ezat, 2017), among others. Varying in these factors across life cycle stages indicates that understanding the effect of OLC on ACB (still undiscovered relationship) offers additional insight on the determinants of such phenomenon. Second, most cost stickiness studies focused mainly on the asymmetric behavior of SGA (e.g., Alavinasab, Mehrabanpour, & Ahmadi, 2017; ABJ, 2003; He, Teruya, & Shimizu, 2010). The current study extends those studies by investigating the stickiness behavior of other costs such as COGS, which represents a large percentage of the cost structure in manufacturing firms, and TC. Third, most cost stickiness studies are conducted in developed countries (e.g., Chen et al., 2012; Weidenmier & Subramaniam, 2003), which leaves a gap to find out how costs behave and what the determinants of such behavior are in less developed countries such as Egypt, which has a different context, especially to generalize the initial results of the ABJ (2003) study and its subsequent studies.

The rest of this study is arranged as follows: Section 2 analyzes the literature review to develop the study hypotheses. Section 3 explains the research methodology by showing the study samples, the empirical model specification, and the statistical techniques employed. Section 4 reports the study's statistical results. Section 5 presents the combined discussion. Section 6 demonstrates conclusions, implications, and limitations.

## **2. Literature Review & Hypotheses Development**

The current study has two main objectives: The first is to explore whether COGS, SGA, or TC behaves asymmetrically in response to change in activity level. The second is to investigate how the nature and degree of ACB vary across the OLC stages.

### *2.1 The Existence of ACB*

ABJ claim that the main reason for ACB is “the deliberate managerial decision” that refers to managers' interventions in a way that affects the cost responsiveness patterns to change in output level. Managers respond differently to demand decreases and demand increases. When demand increases beyond the current capacity level, managers usually increase the level of resources and subsequently the cost, but when demand decreases, managers usually hesitate to cut slack resources (ABJ, 2003). Two main groups of arguments are introduced as the primary interpretation for this asymmetry in managers' response and, therefore, the existence of ACB.

First, adjustment costs, which are inevitable, are higher for downward adjustments than for

upward adjustments (Banker & Byzalov, 2014). As the adjustment cost increases, the cost stickiness increases since rational managers consider keeping idle resources less costly than eliminating and restoring those resources in case of demand recovering (Banker, Ciftci, & Mashruwala, 2006; Rouxelin, Wongsunwai & Yehuda, 2017). Studies provide several determining factors of adjustment costs whether on firm-level, such as employee or assets intensity (e.g., ABJ, 2003; Subramaniam & Watson, 2016; Weidenmier & Subramaniam, 2003), level of employees skills (e.g., Golden, Mashruwala & Pevzner, 2019), firm size (e.g., Dalla Via, & Perego, 2014), and engagement in CSR activities (e.g., Habib & Hasan, 2019) or a country level, such as trade unions bargaining power (e.g., Banker & Chen, 2007), employment protection legislation (e.g., Banker, Byzalov & Chen, 2013; Dierynck, Landsman & Renders, 2012) and employment rate (e.g., Golden et al., 2019).

Second, the changes in sales are more likely to be positive on average (Banker, Byzalov, & Plehn-Dujowich, 2011). Hence, managers tend to be more optimistic than pessimistic about future demand. Optimistic managers are more likely to deal with the decrease in activity level as temporary, so they will prefer not to reduce resources as a response to this decline (in other words, costs become sticky). Prior studies provide several determining factors that derive managerial optimism/pessimism such as; economic growth (e.g., Alavinasab, Mehrabanpour & Ahmadi, 2017; Bugeja, Lu, & Shan, 2015; Ibrahim, 2015), prior period activity change direction (e.g., Banker et al., 2006; Banker, Ciftci, & Mashruwala, 2008), level of idle capacity (e.g., Cannon, 2014; Chen, Kama & Lehavy, 2019), managerial sales forecast (e.g., Kajiwara & Yasukata, 2011; Yasukata, 2011), and analysts sales forecasts (e.g., Banker, Byzalov, Ciftci, & Mashruwala, 2014).

Based on these two arguments, among others, several studies report the existence of ACB for different cost elements including selling, general and administrative costs SGA (e.g., Banker et al., 2006;2008; De Medeiros & Costa, 2004), cost of goods sales COGS (e.g., Ibrahim & Ezat, 2017; Weidenmier & Subramaniam, 2003), operating costs OC (e.g., Banker et al., 2013), and labor cost (e.g., Dalla Via, & Perego, 2014; Dierynck, Landsman, & Renders, 2012), and at different study levels including department-level (e.g., Balakrishnan & Gruca, 2008), firm-level (e.g., Pichetkun & Panmanee, 2012; Dalla Via, & Perego, 2014), industry level (e.g., Golden et al., 2019; Weidenmier & Subramaniam; 2003), and at country-level (e.g., Banker & Chen, 2007; Banker et al., 2013).

Grounded on the previous presentation, it is suggested that the degree of decrease in cost is less than the corresponding degree of increase in costs when sales changes by an equivalent percentage. Therefore, the following hypotheses are considered:

*H1a. COGS demonstrates sticky behavior.*

*H1b. SGA demonstrates sticky behavior.*

*H1c. TC demonstrates sticky behavior.*

## *2.2 The Relationship Between OLC and ACB*

According to the life cycle theory, organizations evolve in predictable developmental stages,

each reflecting a different context concerning resources, capabilities, competencies, strategic orientations, organizational structures, and operating environments (Dickinson, 2011; Kiani et al., 2018; Miller & Friesen, 1984). The core of OLC theory suggests that managerial decisions and organizational performance are considerably affected by the contexts change across life cycle stages. Numerous studies recognize that OLC explains significantly variation in several accounting variables, such as cost of equity (e.g., Hasan, Hossain, & Habib, 2015), capital structure decisions (e.g., La Rocca, La Rocca, & Cariola, 2011), and profitability (e.g., Dickinson, 2011). This suggests that firms that belong to different stages have different characteristics that may influence the nature and degree of ACB.

Introduction-stage firms are described as relatively small and young firms, with simple structure and systems (Miller & Friesen, 1984), face a highly uncertain ambiguous environment (Jir ásek & B Iek, 2018), and have no control over its external environment (Hasan et al., 2015). In addition, young and small firms suffer from their limited ability to reach the public markets (Berger & Udell, 1998). Regarding ACB, literature provides empirical evidence that small firms show anti-stickiness cost behavior (Dalla Via & Perego, 2014). Besides, the costs of firms with limited access to capital are more likely to be anti-sticky due to decreasing the downward adjustment costs (Cheng et al., 2018). Following the previous arguments, the following hypotheses are considered:

*H2a: COGS of introduction firms shows anti-stickiness cost behavior.*

*H2b: SGA of introduction firms shows anti-stickiness cost behavior.*

*H2c: TC of introduction firms shows anti-stickiness cost behavior.*

Growth-stage firms are characterized by several characteristics, including increased size, where structure becomes less centralized, departmental, and more complex (Miller & Friesen, 1984). This suggests that growth firms utilize more assets and hire more employees than those firms in the introduction stage, which in returns increases both assets and employee intensity and consequently have higher adjustment costs. In addition, firms in the growth stage have a higher competitive advantage (Kazanjian, 1988) as they have already built their unique capabilities and competencies (Hatane, Gabrielle & Angelina, 2019), where demand is getting increased in a way that exceeds supply (Jawahar & McLaughlin, 2001), these features increase the managerial optimism about future demand. Following the previous arguments, the following hypotheses are considered:

*H3a: TC of growth firms shows the highest degree of cost stickiness across life cycle stages.*

*H3b: COGS of growth firms shows the highest degree of cost stickiness across life cycle stages.*

*H3c: SGA of growth firms shows the highest degree of cost stickiness across life cycle stages.*

Mature-stage firms show several features such as stable demand levels (Adizes, 1979), where efficiency substitutes innovation. Consequently, they have narrower product scope compared to the growth stage (Su, Baird & Schoch, 2015). Firms in the mature stage are less proactive (Koberg, Uhlenbruck & Sarason, 1996), focusing on exploiting the existing opportunities

rather than exploring new ones (Dufour, Steane & Corriveau, 2018), and allocating more of their resources to corporate social responsibility activities (Hsu, 2018).

These characteristics suggest that the costs of mature firms are stickier than those of introduction firms but less sticky than those of growth firms as mature firms have relatively high adjustment costs and have higher incentives to beat earnings targets and hence reduce costs stickiness. Following the previous arguments, the following hypotheses are considered:

*H3a: TC of mature firms shows a high degree of stickiness across OLC stages.*

*H3b: COGS of mature firms shows a high degree of stickiness across OLC stages.*

*H3c: SGA of mature firms shows a high degree of stickiness across OLC stages.*

Organizations in the shakeout/decline stage demonstrate inconsistent characteristics depending on which stage they were before moving to the current stage. If they moved from the growth or mature stage, then they are the largest, facing the highest level of competition (Hatane et al., 2019) and giving more attention to innovation and diversification in both products and markets (Su et al., 2015), but focusing only on significant products and markets (Jir ásek & B íek, 2018). However, if they moved from the introduction stage, they may suffer from poor performance and the least innovative activities (Miller & Friesen, 1984), indicating negative earnings per share, return on net operating assets, and profit margin (Dickinson, 2011). These characteristics imply a contradictory effect on cost stickiness as increasing size and innovation orientation positively affect the cost stickiness due to an increase in adjustment cost; however, the aggressive competition and poor performance may provoke the need to cut cost rapidly, showing a negative effect on cost stickiness. Following the previous arguments, the following hypotheses are considered:

*H4a: COGS of shakeout/decline firms shows the lowest degree of stickiness across OLC stages.*

*H4b: SGA of shakeout/decline firms shows the lowest degree of stickiness across OLC stages.*

*H4c: TC of shakeout/decline firms shows the lowest degree of stickiness across OLC stages.*

### **3. Method**

#### *3.1 Sample and Data Collection*

The main purpose of this study is to investigate the asymmetric cost behavior phenomena in the context of Egypt. Since cost behavior is more pronounced in manufacturing firms (Dierynck et al., 2012), and due to the homogenous structure of the income statement among these firms, we follow Weiss (2010) in restricting the sample of the current study to only manufacturing firms through the period of 2000-2019. The primary financial data used in our ACB estimation include sales revenues (REV), cost of goods sold (COGS), selling, general & administrative cost (SGA), and total cost (TC). All data are extracted from annual reports published on Thomson Reuter DataStream, Egypt. TC is calculated as sales revenues minus income before tax. To mitigate the negative effect of outliers, we winsorized variables at 95%.



To provide some level of homogenous and minimize the negative effect of outliers, we exclude from the sample firm-year observations with (1) sales revenue less than EGP 10 million and (2) negative total costs, i.e., when income before tax is higher than sales revenues. These procedures of sample selection result in a sample of 1,577 firm-year observations from 99 firms. Table 1 shows the sample distribution according to years, listing state, life cycle stages, and sectors.

Table 1. Sample description

Panel A: Sample Distribution by Year				Panel C: Sample Distribution by Life cycle Stage		
Year	N	Year	N	Life cycle stage	N	%
2000	43	2010	81	Introduction	180	11.4
2001	53	2011	84	Growth	230	14.6
2002	58	2012	90	Mature	822	52.1
2003	64	2013	92	Shakeout/decline	345	21.9
2004	66	2014	94	Total	1577	100.0
2005	70	2015	96	Panel D: Sample Distribution by sectors		
2006	74	2016	94	Sector	N	%
2007	80	2017	94	Basic Resources	282	17.9
2008	81	2018	92	Building Materials	203	12.9
2009	78	2019	93	Contracting & Construction	113	7.2
		Total	1577	Food & Beverages	448	28.4
Panel B: Sample Distribution by listing				Health Care & Pharmaceuticals	217	13.8
Listing state	N	%		Industrial Goods	114	7.2
EGX 100	916	58.1		Paper & Packaging	49	3.1
Non-EGX 100	661	41.9		Textile & Durables	151	9.6
Total	1577	100.0		Total	1577	100.0

### 3.2 Variable Measurement and Empirical Models

#### 3.2.1 Life Cycle Stage Classification

Several proxies have been employed to capture the stage in which a firm is such as size, retained earnings, age, assets growth, and sales growth (e.g., DeAngelo, DeAngelo, & Stulz, 2010; Faff, Kwok, Podolski, & Wong, 2016; Owen & Yawson, 2010). Among the limitations addressed to these proxies is that they don't evolve monotonically across life cycle stages. This means that the same level of the proxy variable may give two different classifications (Faff et al., 2016). Dickinson (2011) introduces a new proxy that captures the cyclical nature of OLC by employing signs of the three cash flows components (operating cash flow =OCF, investing cash flow =ICF, financing cash flow = FCF). Table 2 shows how firms are classified into one of five life cycle stages.

Table 2. Dickinson life cycle stages classification

	<b>Introduction</b>	<b>Growth</b>	<b>Mature</b>	<b>Shake-Out</b>			<b>Decline</b>	
Cash Flow	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
1. OCF	–	+	+	+	+	–	–	–
2. ICF	–	–	–	+	+	–	+	+
3. FCF	+	+	–	+	–	–	+	–

For the purposes of this study, we classify firm-year observations based on Dickinson's methodology into four stages, including introduction stage (firm-year observations with  $OCF < 0$ ,  $ICF < 0$ , and  $FCF < 0$ ), growth stage (firm-year observations with  $OCF > 0$ ,  $ICF < 0$ , and  $FCF > 0$ ), mature stage (firm-year observations with  $OCF > 0$ ,  $ICF < 0$ , and  $FCF < 0$ ), and shakeout/decline stage (for all other firm-year observations).

#### 3.2.2 Asymmetric Cost Behavior and Life Cycle Effect

The most common model for estimating ACB that is employed by the majority of cost stickiness literature is the model of ABJ (2003), which depends on an interaction dummy variable that distinguishes between activity-increasing periods and activity-decreasing periods to capture cost stickiness as follows:

$$\log\left(\frac{Cost_{i,t}}{Cost_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \beta_2 \log\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) * DEC + \varepsilon_{i,t}$$

Where;  $i$  represents the company  $i$ ;  $t$  represents the year  $t$ ; Cost represents SGA; Sales represent sales revenues; and DEC is a dummy variable that equals 1 if  $Sales_{i,t} < Sales_{i,t-1}$  and 0 otherwise. Log specification has been used to enhance the comparability and also accommodates economic interpretation of the estimated coefficients.



Since a DEC variable takes the value of 0 when sales increase, the coefficient  $\beta_1$  estimates the increasing percentage in costs resulting from a 1% increase in sales revenue, while the sum of coefficients ( $\beta_1 + \beta_2$ ) estimates the decrease percentage in costs responding to a 1% decrease in sales revenue. This means that the coefficient  $\beta_2$  illustrates the average degree of cost stickiness by capturing the degree of cost response relating to sales decreases versus increases. Statistically, cost stickiness (anti-stickiness) is proved when there is a significant negative (positive) coefficient  $\beta_2$  conditional on a positive coefficient  $\beta_1$ .

To fulfill the first objective of this study, related to investigate the nature and degree of ACB, we replicate the pioneer model of ABJ (2003) for three proxies of costs, including COGS, SGA, and TC, as follows:

$$\text{Model (1): } \log\left(\frac{COGS_{i,t}}{COGS_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC + \varepsilon_{i,t} \quad (1)$$

$$\text{Model (2): } \log\left(\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC + \varepsilon_{i,t} \quad (2)$$

$$\text{Model (3): } \log\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC + \varepsilon_{i,t} \quad (3)$$

Where  $COGS_{i,t}$ ,  $SGA_{i,t}$  and  $TC_{i,t}$  refer respectively to cost of goods sold, the selling, general and administrative cost, and the total cost for the firm  $i$  at year  $t$ , while  $REV_{i,t}$  stands for the sales revenue for the firm  $i$  at the time  $t$ . DEC is a dummy variable that equals 1 if the sale revenue of the current period is lower than the previous period value and 0 otherwise.

This study reruns the pre-mentioned three models separately for firm-year observations in each life cycle stage to explore the effect of the life cycle stage on the nature and the degree of ACB.

## 4. Results

### 4.1 Descriptive Statistics

Table 3 shows the basic descriptive statistics related to the main study variables (REV, COGS, SGA, and TC).

Panel A of Table 2 provides descriptive statistics concerning revenue and all costs proxies. The mean (median) values of revenues, COGS, SGA, and TC are respectively 1,163,130 (1,225,168), 889,280 (938,276), 79,794 (88,075), 981,591 (1,463,127). All variables' mean and median values are reasonably close, so we can assume that their data is distributed normally. The mean percentage of COGS to sales revenues (79.31%) is relatively higher than the mean percentage of SGA to sales revenues (9.16%), reflecting the importance of COGS in the cost structure of Egyptian manufacturing firms.

Table 3. Descriptive statistics

Paned A: Descriptive Statistics for Annual Revenues & Costs from 2000 to 2019					
	Mean	Stand. Dev.	1 <sup>st</sup> Q	Median	3 <sup>rd</sup> Q
REV	1,163,130	413,148	169,647	1,225,168	1,759,622
COGS	889,280	311,244	131,400	938,276	1,336,090
SGA	79,794	26,352	9,162	88,075	123,019
TC	981,591	362,877	145,203	1,045,796	1,463,127
COGS As a percentage of REV	79.31%	80.67%	15.50%	71.55%	88.79%
SGA As a percentage of REV	9.16%	6.92%	3.35%	11.50%	19.06%
TC As a percentage of REV	88.75%	90.74%	17.95%	81.99%	97.40%

  

Panel B: Descriptive Statistics for Annual Revenues & Costs according to life cycle stage					
		Introduction	Growth	Mature	Shake/Decline
REV	Mean	1,030,726	1,168,715	1,321,608	850,897
	Std. Deviation	1,871,800	1,829,524	1,345,128	1,760,180
COGS	Mean	798,814	908,389	986,169	692,892
	Std. Deviation	1,393,899	1,416,499	1,404,242	1,032,021
SGA	Mean	90,153	102,748	80,812	54,657
	Std. Deviation	143,806	145,597	123,324	80,472
TC	Mean	906,157	1,033,185	1,076,788	759,519
	Std. Deviation	1,556,934	1,566,645	1,524,007	1,139,604

  

Panel C: Periodic Fluctuations in Revenues & Costs from 2000 to 2019						
	Percentage of observations with negative change percentage	Mean of percentage decrease over periods	The standard deviation of percentages decreases over periods	1 <sup>st</sup> Q of percentage decrease over periods	Median of percentage decrease over periods	3 <sup>rd</sup> Q of percentage decrease over periods

REV	26.51%	16.59%	17.13%	22.35%	10.41%	4.53%
COGS	25.11%	15.64%	17.15%	20.94%	9.45%	3.86%
SGA	23.34%	15.76%	16.62%	20.15%	10.20%	4.78%
TC	25.17%	16.70%	18.49%	21.46%	10.72%	4.03%

\* All the reported numbers are in thousands of EGP.

Panel B of Table 2 provides descriptive statistics (mean and standard deviation) of revenue and all costs categories according to life cycle stages. Consistent with life cycle theory, except for SGA, all the mean values of investigated variables increase from introduction to mature stage then falls in shakeout/decline stage. For example, the mean value of revenues for introduction firms is 1,030,726, increases to 1,168,715 for growth firms, then increases to 1,321,608 for mature firms but falls to 850,897 for firms in the shakeout/decline stage.

Panel C of Table 2 shows the percentage of firm-year observations (frequency of firm-years) when revenues and costs variables decrease in the current period relative to the prior period. The frequency percentage of the firm-year observations when costs fell (from 23.34% to 25.17%) is relatively less than when revenues fell (26.51%). Also, except for total cost, which has a mean value of decrease of about 16.7%, the mean value of reductions in revenue (16.59%) is relatively higher than that of reductions in costs 15.64% and 15.76% for COGS and SGA, respectively, which may provide a sing for the existence of cost stickiness.

#### 4.2 Hypotheses Testing Results

Following prior studies in asymmetric cost behavior, we employ Ordinary Least Squares (OLS) to estimate the cost stickiness model for the entire sample first, then we test the effect of the life cycle on the nature and magnitude of asymmetric cost behavior. The following section shows the regression results regarding these two groups of tests.

##### 4.2.1 Nature and Degree of ACB

Table 4. Results of regressing annual changes in costs on annual changes in sales revenue

#### Regression specification:

$$Model (1): \log\left(\frac{COGS_{i,t}}{COGS_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC + \varepsilon_{i,t}$$

$$Model (2): \log\left(\frac{SG\&A_{i,t}}{SG\&A_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC + \varepsilon_{i,t}$$

$$Model (3): \log\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right) = \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC + \varepsilon_{i,t}$$

<i>Model (1)</i>		<i>Model (2)</i>		<i>Model (3)</i>	
Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic

$\hat{\beta}_0$	0.017***	10.199	0.041***	13.317	- 0.020***	9.772
$\hat{\beta}_1$	0.566***	42.520	0.246**	10.248	0.537***	34.351
$\hat{\beta}_2$	- 0.142***	- 6.043	- 0.098***	- 2.297	- 0.145***	- 5.237
$\hat{\beta}_1 + \hat{\beta}_2$	0.424		0.15		0.392	
Adjusted R <sup>2</sup>	0.654601		0.090411		0.549908	
Durbin-Watson	2.226		2.078		2.338	
N	1577		1542		1577	
Prob.	0.000		0.000		0.000	

\*\*\*, \*\*, \* significant at 1%, 5%, and 10% levels, respectively

Using Panel Least Squares for the pooled sample (Note 1). Table 4 demonstrates the results of regressing the annual changes in each of COGS, SGA, and TC on the annual change of sales revenues.

Concerning the COGS model, the estimated value of  $\beta_1$  is 0.566, implying that COGS increases by approximately 0.57% for each 1% increase in sales revenues. The estimated value of  $\beta_2$  is negative at - 0.142, and the sum of estimated coefficients  $\beta_1 + \beta_2$  is 0.424, implying that the COGS decreases only by approximately 0.42% for each 1% decrease in sales revenues which reveals that COGS exhibits stickiness behavior.

Regarding the SGA model, the estimated value of  $\beta_1$  is 0.246, implying that SGA increases by approximately 0.25% for each 1% increase in sales revenues. The estimated value of  $\beta_2$  is negative at - 0.098, and the sum of estimated coefficients  $\beta_1 + \beta_2$  is 0.148, implying that the SGA decreases by approximately 0.15% for each 1% decrease in sales revenues. This means that SGA exhibits stickiness behavior.

Regarding the TC model, the estimated value of  $\beta_1$  is 0.537 (t-statistic = 34.351), implying that TC increases by approximately 0.54% for each 1% increase in sales revenues. The estimated value of  $\beta_2$  is negative and equals - 0.145 (t-statistic = - 5.237), and the sum of estimated coefficients  $\beta_1 + \beta_2$  is 0.392, implying that the TC decreases by approximately 0.39% for each 1% decrease in sales revenues. This means that TC exhibits stickiness behavior.

We compute the relative percent decrease to increase RPD in cost to compare the degree of stickiness among the three costs proxies. A lower value of RPD reflects a higher degree of stickiness. SGA has the highest degree of costs stickiness with RPD at 0.60 (0.15/0.25), followed by TC with RPD at 0.72(0.39/.54), and finally, COGS has the lowest degree of costs stickiness with RPD at 0.74 (0.42/0.57).

#### 4.2.2 The Effect of OLC on ACB

Table 5 shows the results of running the three regression models separately for each group of firm-year observations belonging to a specific life cycle stage.

For introduction firms, the coefficient  $\beta_1$  in the COGS (TC) model is 0.39 (0.28) indicating that COGS (TC) increase by approximately 0.39% (0.28%) for each 1% increase in sales revenues. The coefficient  $\beta_2$  is positive at 0.58 (0.70), and the sum of coefficients  $\beta_1 + \beta_2$  is 0.97 (0.98), implying that the COGS (TC) of introduction firms decreases by approximately 0.97% (0.98%) for each 1% decrease in sales revenues. This means both COGS and TC demonstrate anti-stickiness cost behavior for introduction-stage firms. Both  $\beta_1$  and  $\beta_2$  are significant at a 1% level.

For growth firms, the coefficient  $\beta_1$  in the COGS (TC) model is 0.38 (0.37) indicating that COGS (TC) increase by approximately 0.38% (0.39%) for each 1% increase in sales revenues. The coefficient  $\beta_2$  is negative at  $-0.18$  ( $-0.17$ ), and the sum of coefficients  $\beta_1 + \beta_2$  is 0.20 (0.20), implying that the COGS (TC) of growth firms decrease by approximately 0.20% (0.20%) for each 1% decrease in sales revenues. This means both COGS and TC demonstrate stickiness cost behavior in mature-stage firms. Both  $\beta_1$  and  $\beta_2$  are significant at a 1% level.

For mature firms, the coefficient  $\beta_1$  in the COGS, SGA, and TC models indicate that these cost proxies increase by approximately 0.73%, 0.33%, and 0.71 respectively for each 1% increase in sales revenues. The coefficient  $\beta_2$  is negative for all costs. Both  $\beta_1$  and  $\beta_2$  are significant for the three models at a 1% level. Given the sum of coefficients,  $\beta_1 + \beta_2$  of three models indicate that the COGS, SGA, and TC of mature firms decrease only by approximately 0.51%, 0.06%, and 0.46 respectively, for each 1% decrease in sales revenues. This means all proxies of costs demonstrate stickiness cost behavior in mature-stage firms.

Table 5. Regression results of cost stickiness models across life cycle stages

	Coefficient estimates				$(\beta_1 + \beta_2) / \beta_1 = \text{RPD}$	Adj. $R^2$	N
	$\beta_0$	$\beta_1$	$\beta_2$	$\beta_1 + \beta_2$			
<b>Introduction</b>							
COGS	0.05***	0.39***	0.58***	0.97	2.49	0.67	180
SGA	0.04***	0.27***	0.15	–	–	0.17	180
TC	0.06***	0.28***	0.70***	0.98	3.50	0.50	180
<b>Growth</b>							
COGS	0.03***	0.38***	$-0.18$ ***	0.20	0.53	0.49	230
SGA	0.06***	0.22***	$-0.08$	–	–	0.11	277

TC	0.03***	0.37***	- 0.17***	0.20	0.54	0.40	230
<b>Mature</b>							
COGS	0.01***	0.73***	- 0.22***	0.51	0.70	0.75	822
SGA	0.03***	0.33***	- 0.27***	0.06	0.18	0.08	804
TC	0.0***	0.71 ***	- 0.25***	0.46	0.69	0.66	822
<b>Shakeout/decline</b>							
COGS	0.01**	0.64***	- 0.15***	0.49	0.77	0.77	345
SGA	0.04***	0.09*	0.13	-	-	0.05	331
TC	0.01*	0.64***	- 0.18***	0.46	0.72	0.66	345

\*\*\*, \*\*, \* significant at 1%, 5%, and 10% levels, respectively

For shakeout/decline stage firms,  $\beta_1$  in COGS (TC) model is 0.64 (0.64) indicating that COGS (TC) increases by approximately 0.64% (0.64%) for each 1% increase in sales revenues. The coefficient  $\beta_2$  is negative at - 0.15 (- 0.18), and the sum of coefficients  $\beta_1 + \beta_2$  is 0.49 (0.46), implying that the COGS (TC) of shakeout/decline-firms decreases only by approximately 0.49% (0.46%) for each 1% decrease in sales revenues. This means both COGS and TC demonstrate stickiness cost behavior of shakeout/decline-stage firms. Both  $\beta_1$  and  $\beta_2$  are significant at a 1% level.

The insignificance of  $\beta_2$  conditional on the significance of  $\beta_1$  in the SGA model indicates no significant difference between the increasing percentage and decrease percentage of SGA (i.e., SGA behaves symmetrically) for firms in the introduction, growth, and shakeout/decline stages.

To compare the degree of COGS and TC across life cycle stages, RPD is computed. The RPD column in Table 5 indicates that both COGS and TC have their highest (lowest) degree of cost stickiness for firms in the growth (shakeout/decline) stage at a value of RPD at 0.53 (0.77) for COGS and 0.54(0.72) for TC. Mature firms show a moderate degree of costs stickiness with a value of RPD at 0.70 for COGS and 0.69 for TC.

#### 4.2.3 Robustness Test

To confirm the previous results related to the effect of OLC on ACB, instead of running separate regression, we incorporate dummy variables into the ABJ model to capture. Three dummy variables are included, namely GRTH, MATUR, and SHKDEC taking the introduction stage as a benchmark. Also, to estimate both the increase and decrease percentage relative to one percent change in sales revenue, each stage dummy variable is introduced twice, with and without the decrease indicator. The general model after incorporating these dummy variables of is presented as follows:



### OLC Model

$$\begin{aligned}
 \log\left(\frac{COST_{i,t}}{COST_{i,t-1}}\right) = & \beta_0 + \beta_1 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) + \beta_2 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * DEC \\
 & + \beta_3 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * GRTH + \beta_4 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * GRTH * DEC \\
 & + \beta_5 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * MATUR + \beta_6 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * MATUR * DEC \\
 & + \beta_7 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * SHKDEC + \beta_8 \log\left(\frac{REV_{i,t}}{REV_{i,t-1}}\right) * SHKDEC * DEC + \varepsilon_{i,t} \quad (4)
 \end{aligned}$$

Where,  $COST_{i,t}$  reflects each of  $COGS_{i,t}$  (for model 1),  $SGA_{i,t}$  (for model 2), and  $TC_{i,t}$  (for model 3).  $GRTH$  is a dummy variable that takes the value of 1 if the firm (i) at year (t) is in the growth stage and 0 otherwise.  $MATURE$  is a dummy variable that takes the value of 1 if the firm (i) at year (t) is in the mature stage and 0 otherwise.  $SHKDEC$  is a dummy variable that takes the value of 1 if the firm (i) at year (t) is in the shakeout/decline stage and 0 otherwise. Table 6 shows the results of the regression of the previous model.

Since the introduction stage is the benchmark for the regression model, the coefficient  $\beta_1$  captures the estimated increase percentage in the investigated cost for a 1% increase in sales level. The sum of coefficients  $\beta_1 + \beta_2$  captures the estimated decrease percentage in the investigated cost for a 1% decrease in sales level for firms in the introduction stage.

Each of the coefficients  $\beta_3$ ,  $\beta_5$ , and  $\beta_7$  captures the differential percentage in estimated increase percentage of the investigated costs for a 1% increase in sales level for firms in growth, mature, and shakeout/decline stage, respectively. More specifically, the sum of coefficients  $(\beta_1 + \beta_3)$ ,  $(\beta_1 + \beta_5)$ , and  $(\beta_1 + \beta_7)$  captures the estimated increase percentage in the investigated cost for to a 1% increase in sales level for firms in growth, mature, and shakeout/decline stage respectively. Similarly, the sum of coefficients  $(\beta_1 + \beta_2 + \beta_3 + \beta_4)$ ,  $(\beta_1 + \beta_2 + \beta_5 + \beta_6)$ , and  $(\beta_1 + \beta_2 + \beta_7 + \beta_8)$  captures the estimated decrease percentage in the investigated cost for to a 1% increase in sales level for firms in growth, mature, and shakeout/decline stage respectively.

The previous interpretation is valid only when the coefficients are significant; however, they should be interpreted differently when the coefficients are insignificant. For example, the insignificant coefficients  $\beta_2$  and  $\beta_8$  in the SGA model may be interpreted as there is no significant difference between the increase and decrease percentage of SGA (i.e., SGA behaves symmetrically) for firms in the introduction and shakeout/decline stages. The insignificant coefficient  $\beta_3$  in the SGA and TC models may be interpreted as there is no significant difference between the growth firms and introduction firms regarding the increasing percentage of SGA and TC. Similarly, the insignificant coefficient  $\beta_5$  in the SGA model may be interpreted as there is no significant difference between mature firms and introduction firms concerning the increasing percentage of SGA.

Table 6. Results of regression testing the effect of OLC and ACB

	<i>Model (1)</i>		<i>Model (2)</i>		<i>Model (3)</i>	
	<u>Coeff.</u>	<u>t-stat.</u>	<u>Coeff.</u>	<u>t-stat.</u>	<u>Coeff.</u>	<u>t-stat.</u>
$\hat{\beta}_0$	0.018***	11.145	0.042***	13.196	0.020***	10.098
$\hat{\beta}_1$	0.504***	21.750	0.273***	6.122	0.429***	15.301
$\hat{\beta}_2$	0.251***	3.384	0.136	0.952	0.290***	3.231
$\hat{\beta}_3$	- 0.069 **	- 2.307	0.017	0.300	- 0.000	- 0.012
$\hat{\beta}_4$	- 0.510***	- 6.412	- 0.221**	- 2.135	- 0.544***	- 5.650
$\hat{\beta}_5$	0.173***	6.005	0.005	0.082	0.220***	6.305
$\hat{\beta}_6$	- 0.370***	- 4.656	- 0.231**	- 2.079	- 0.433***	- 4.405
$\hat{\beta}_7$	0.091***	2.870	- 0.180***	- 2.935	0.166***	4.337
$\hat{\beta}_8$	- 0.311***	- 3.876	- 0.006	- 0.036	- 0.407***	- 4.198
Adjusted R <sup>2</sup>	0.70		0.10		0.59	
No. of observations	1577		1542		1577	
Prob(F-statistic)	0.000		0.000		0.000	

\*\*\*, \*\*, \*significant at 1%, 5%, and 10% levels, respectively

Based on the previous presentation, Table 7 shows the increase (INC) and decrease (DEC) percentages of change in three cost categories for a 1% increase and decrease in sales level, and also the relative percent of reduction to increase (RPD) as follow.

Table 7. Asymmetric Cost Behavior across life cycle stages

Stage	Introduction			Growth			Mature			Shakeout/decline		
	INC	DE C	RPD	INC	DE C	RPD	INC	DE C	RPD	INC	DE C	RPD
<b>COGS</b>	0.50	0.76	1.52	0.44	0.18	0.41	0.68	0.56	0.82	0.60	0.54	0.90
<b>SGA</b>	0.27	0.27	1	0.27	0.05	0.19	0.27	0.04	0.15	0.09	0.09	1
<b>TC</b>	0.43	0.72	1.67	0.43	0.18	0.42	0.65	0.51	0.78	0.60	0.48	0.80

\* RPD>1 indicates that costs are anti-sticky, while RPD<1 demonstrates that costs are sticky. RPD=1 means that costs behave symmetrically.

The RPD column of Table 7 indicates that COGS and TC are anti-sticky in the introduction stage but sticky in all other stages (growth, mature, and shakeout/decline stages), with the highest (lowest) degree of stickiness in growth (shakeout/decline) stage. In contrast, SGA costs are sticky only in the growth and mature stages but behave symmetrically in the introduction and shakeout/decline stages. The results are so close to those of separate regressions run before, which confirm the previous results.

## 5. Discussion

A considerable body of literature reports the existence of ACB. The current study attempts to extend the literature by investigating the ACB in the Egyptian context. The study examines the ACB at two levels of analysis: First, the study explores the nature and degree of cost stickiness using several proxies of costs. The results demonstrate that all the investigated costs (COGS, SGA, and TC) exhibit stickiness behavior; specifically, they decrease less than they increase when the activity level changes by an equivalent percentage. However, the degree of cost stickiness is different across these different cost accounts, which confirms the expectations of Banker et al. (2014). Comparing the degree of stickiness among the three costs examined shows that TC exhibits the highest stickiness degree, while COGS shows the lowest degree. This result may be attributed to several reasons. One reason is that the cost structure of COGS comprises more variable costs compared to SGA. In addition, direct material, which constitutes a high percentage of COGS, is proved to be anti-sticky (Ghaemi, & Nematollahi, 2011).

Second, the study examines the effect of OLC on ACB. Despite the stickiness behavior of COGS, SGA, and TC, ACB differs across the different stages of OLC. Consistent with our conjectures, costs tend to be anti-sticky for firms in the introduction stage but sticky for firms in the other stages. Two main justifications may be discussed here; the difference in both adjustment costs and managerial optimism. As introduction firms are relatively small, young, and have simple structure and systems (Miller & Friesen, 1984), adjustment costs are more likely to be lower than those of other stages firms.

Moreover, the high ambiguity about the environment negatively affects managerial optimism, which correlates directly with cost stickiness (ABJ, 2003). Subsequently, it encourages managers to cut costs rapidly when the activity level falls. In addition, firms in the introduction stage may have a higher incentive to avoid losses, and costs tend to be ant-sticky when managers have higher incentives to avoid losses (Kama & Weiss, 2013).

## 6. Conclusion

In this study, we have investigated the nature and degree of ACB and how life cycle stages may affect it. We argue that costs exhibit stickiness behavior in general; however, this behavior is affected by the firm's life cycle stage. With regard to the first group of hypotheses, the results show that all three costs proxies are sticky and therefore accepting each of H1a, H1b, and H1c. With regard to the second group of hypotheses, only H2a and H2c are accepted, while H2b is rejected. Regarding the third group of hypotheses, all hypotheses are accepted. Finally, both H4a and H4c are accepted, but H4b is rejected. Table 8 summarizes the results of hypotheses testing.

Table 8. Summary of Hypothesis Testing Results

<b>H1a</b>	Accepted	<b>H1b</b>	Accepted	<b>H1c</b>	Accepted
<b>H2a</b>	Accepted	<b>H2b</b>	Rejected	<b>H2c</b>	Accepted
<b>H3a</b>	Accepted	<b>H3b</b>	Accepted	<b>H3c</b>	Accepted
<b>H4a</b>	Accepted	<b>H4b</b>	Rejected	<b>H4c</b>	Accepted

The results of this study reveal several implications for both managerial and financial accounting, as cost behavior analysis plays significant roles in both streams. For example, standard costing techniques should consider the inconstant change rate in cost depending on activity change direction. Similarly, the process of earnings forecasts and firm evaluation should be conducted assuming that costs behave differently to upwards and downwards activity level change. The additional noteworthy implication is that decision-makers should consider the life cycle stage of the organization when estimating costs for different purposes, as there is strong evidence that costs are anti-sticky for introduction stage firms but sticky in all other stages, considering that growth firms have the highest degree of costs stickiness, while shakeout/decline firms have the lowest degree of cost stickiness.

A limitation of this study is that it did not control for several internal and external determining factors that have been proved to affect ACB, such as asset intensity, inventory intensity, firm size, and economic growth, as the main argument we propose is that life cycle stage should reflect the combined effect of internal and external context of the organization.

Future research might examine the influence of OLC on ACB in a different context, such as non-manufacturing sectors, and find out how the type of sector may moderate this influence. Moreover, most cost stickiness studies have focused on the determinants that affect ACB, with little attention given to the consequences of such a phenomenon. So, future research may focus on the effect of ACB on several aspects, such as costing systems, earnings forecast accuracy, and budgeting approaches.

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### Note

Note 1. The results did not change when using a fixed-effect model.

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