Does Asymmetric Cost Behavior Reduce Over Time? "Evidence from the Lagged Effect of Investment Intensity on Operating Cost and SG&A Cost"

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Abstract

Purpose - Cost reacts in an asymmetric way to increase and decrease in the volume of the cost driver. This study aims to investigate how investment intensity affects this asymmetric cost behavior. It examines the effect of capital expenditure and PPE investment on the asymmetric cost behavior of operating cost and SG&A cost. In addition, this study extends prior literature by examining the lagged effect of investment intensity on the asymmetric cost behavior of operating cost and SG&A cost.

Design/Methodology/Approach – This study uses Anderson et al. (2003) baseline model to measure asymmetric cost behavior of operating cost and SG&A cost and the effect of investment intensity on the asymmetric cost behavior. In addition, the model is developed by including the lagged investment intensity to capture its effect on the asymmetric cost behavior of operating cost and SG&A cost.

Findings - The empirical results demonstrate that: i) the degree of asymmetric cost behavior of operating cost and SG&A cost is increased by investment intensity. ii) the lagged investment intensity decreases the asymmetric cost behavior of operating cost and SG&A cost. iii) the asymmetric cost behavior decreases over time.

Research limitations/implications - The study is based solely on one year lagged effect and does not control for firm`s life cycle (i.e., firm's age). Future research will be useful to conduct comparative studies of cost behavior at different stages of firm`s life cycle.

Practical implications –One of the significant implications of this study is to advance the understanding of how investment intensity affects asymmetric cost behavior and how this would be reflected in the cost modeling and managerial decisions.

Originality/Value - There are several important areas where this study makes an original contribution to management accounting literature. This study extends the scope of the literature on asymmetric cost behavior by providing evidence that capital expenditure and PPE investment are main determinants of asymmetric cost behavior. In addition, this effect of investment intensity on asymmetric cost behavior is transitory and reduces overtime.

Keywords – asymmetric cost behavior; operating cost; SG&A cost; investment intensity; capital expenditures; ancillary cost; lagged effect.

1. Introduction

Understanding cost behavior is a fundamental property of understanding managerial decisions about cost structure. To date there has been little agreement on what traditionally has been accepted about cost behavior that the cost increases in a systematic way with the increase in cost drivers. More specifically, the cost increases after the increase in cost driver with the same volume of the cost decrease within the same decrease in the cost driver. Although extensive research has been carried out on the traditional cost modeling, which indicates a systematic cost behavior, the cost has asymmetric behavior. Anderson et al. (2003) reexamine what traditionally has been accepted about cost behavior by introducing the term of "Sticky Cost" which reflects the asymmetric cost behavior. From a general perspective, sticky cost could be defined as cost reacting in an asymmetric way to increase and decrease in the volume of the cost driver. Anderson et al. (2003) prove the increase in sales, general and administrative cost (hereafter, SG&A cost) for a given sales volume is higher than the decrease in SG&A cost for the same decrease in sales volume. In which the cost behavior is to be considered as asymmetric behavior. In addition, Weiss (2010) reaches the same conclusion with application of COGS (cost of goods sold). Dierynck et al. (2012) document cost stickiness for labor cost and Shust and Weiss (2014) document the asymmetric cost behavior of operating cost. Many scholars now argue that the asymmetric cost behavior has been approved in different contexts. Banker and Byzalov (2014), for example, document the asymmetric cost behavior in many countries and industries.

The phenomena of cost stickiness indicate that cost decreases to a lesser extent with a decrease in revenue than the extent to which cost increases with an increase in revenue. Then, this asymmetric cost behavior would be reflected in the cost modeling and managerial decisions. Guenther et al. (2014) explain such

asymmetric cost behavior that after sales volume decreases the retaining capacity leads to this asymmetric cost behavior. Whereas, retaining capacity does not lead to cost reduction, however, retaining capacity leads to adjusted cost structures which at the end lead to asymmetric cost behavior. More recently, literature has emerged offers three significant determinants that affect the level of cost asymmetry. First: the magnitude of the adjustment cost. Managers compare adjustment costs which result from downsizing with holding costs. If the adjustment cost tends to be higher than holding cost the managers tend to retain capacity. Second: managers' expectations about future sales. If managers expect an increase in the future sales, they avoid downsizing in the short term to maximize their benefits from sales increase in the future. Therefore, the firm incurs more additional cost to retain its maximum capacity. Third: managerial incentives; managers, in firms with limited corporate governance, may opportunistically delay the adjustments of resources usage to avoid disclosure about deficiencies in investment decisions (Banker et al., 2018).

Recently, investigators have examined the reasons for asymmetric cost behavior according to its determinants. For instance, in the term of adjustment cost -within a rational analysis- the asymmetric cost behavior results from the managers` decision to avoid adjustment cost and maintain resources (Anderson et al. 2003; Dierynck et al. 2012; Balakrishnan et al., 2014). In addition, the regulations of labor protection and the types of resources used by firms are the reasons for managers` decisions to maintain unused capacity which leads to asymmetric cost behavior (Banker et al. 2013; Venieris et al. 2015; Golden et al. 2020). It is also worth noting that several attempts in studying cost behavior in management accounting literature have been made to measure these determinants. For example, the determinant of adjustment cost could be measured using asset and employee intensity (Anderson et al., 2003).

The past decade has seen a rapid development of understanding cost behavior after Anderson et al. introduction in 2003. This study aims to contribute to this growing area of research by exploring a determinant that affect the asymmetric cost behavior. More specifically, this study examines if capital expenditure and net property, plant and equipment (hereafter, PPE) investment, on the firm-level, increase the asymmetric cost behavior of operating cost and SG&A cost. The asymmetric operating cost behavior is documented in previous studies (Shust and Weiss, 2014), similarly with asymmetric SG&A cost behavior (Anderson et al., 2003). In addition, capital expenditure and PPE investment is capitalized until the usage of these investments then any additional cost is expended. As the amounts of capital expenditure and PPE investment are capitalized to the assets in the balance sheet until the assets are ready to be used for the intended purpose. Then all subsequent ancillary costs are expended in the income statement, this ancillary cost leads to the asymmetric cost behavior. Thus, it is expected that the phenomena of asymmetric cost behavior also emerges from capital expenditure and PPE investment. However, there has been little quantitative analysis of investigating the effect of investment intensity on asymmetric cost behavior. Therefore, this study aims to investigate how investment intensity affects this asymmetric cost behavior in emerging context, Egypt. It examines the effect of capital expenditure and PPE investment on the asymmetric cost behavior of operating cost and SG&A cost. In addition, this study extends prior literature by examining the lagged effect of investment intensity on the asymmetric cost behavior of operating cost and SG&A cost. The empirical results demonstrate that the degree of asymmetric cost behavior of operating cost and SG&A cost is increased by investment intensity. It is interesting to note that in all data sets of operating cost and SG&A cost the lagged investment intensity decreases the asymmetric cost behavior.

There are several important areas where this study makes an original contribution to management accounting literature. Previous studies of asymmetric cost behavior have not dealt with investment intensity effect on operating cost and SG&A cost in emerging context. Study of Hoglund et al. (2022), which shows how firm-level investment intensity in PPE explains

the asymmetric cost behavior, the study was limited to SG&A cost and applied on a data set obtained from US firms. This study lies beyond the scope of Hoglund et al. (2022) by investigating the effect of investment intensity on operating cost as well as SG&A cost. As a significant amount of capital expenditure and PPE investment would be oriented to increase production capacity or to provide firms with long-term investments that increase operating capacity. Therefore, this study extends the scope of literature on asymmetric cost behavior by providing evidence that capital expenditure and PPE investment are main determinants of asymmetric cost behavior of operating cost and SG&A cost. In addition, this study extends prior literature by examining the lagged effect of investment intensity on the asymmetric cost behavior of operating cost and SG&A cost. The results indicate that the degree of asymmetric cost behavior of operating cost and SG&A cost is increased by investment intensity measured by capital expenditure and net PPE. However, the lagged investment intensity decreases the asymmetric cost behavior of operating cost and SG&A cost. Therefore, it is concluded that the asymmetric cost behavior is transitory and reduced overtime. The paper proceeds as follows: section 2 provides literature review and develops research hypotheses. Section 3 defines data, provides descriptive statistics for the full sample and section 4 develops empirical models. Section 5 provides empirical results, section 6 provides additional tests, section 7 discusses main results, section 8 suggests future research.

2. Prior Literature and Hypotheses Development

2.1. Main Determinants of Asymmetric Cost Behavior

One of the most significant current discussions in the management accounting literature is cost behavior. The past decade has seen the rapid development of understanding cost behavior after Anderson et al. (2003) introduction of asymmetric cost behavior. The three significant determinants of asymmetric cost behavior have been investigated intensively in management accounting literature. A large and growing body of literature has provided more definitive evidence of adjustment costs as a determinant of asymmetric cost behavior. Anderson et al. (2003) find the increase in SG&A cost

for a given sales volume is larger than the decrease in SG&A cost for the same decrease in sales volume. Anderson et al. (2003) explain such asymmetric cost behavior that managers avoid adjustment costs by retaining unused capacity which in the end leads to asymmetric cost behavior. Banker et al. (2013) find high level of labor legislation leads to asymmetric cost behavior due to the increase of adjustment costs for labor. Also, Balakrishnan et al. (2014) and Banker et al. (2018) find managers prefer to retain unused capacity to avoid adjustment costs which lead to asymmetric cost behavior. Moving to the determinant of managers` expectation about future sales structure; Banker et al. (2014) and Chen et al. (2019) find managers retain unused capacity during the periods of sales decrease. This is a result of that managers confidently expect increase sales in the future which leads to asymmetric cost behavior.

2.2. *Asymmetric Cost Behavior and Managerial Incentives*

Managers` incentives are considered as a main driver of asymmetric cost behavior. Chen et al. (2013) find firms have high level of asymmetric cost behavior have managers with high level of optimism. Kama and Weiss (2012) find evidence that opportunistic behavior of managers to meet earnings forecasts leads to asymmetric cost behavior. In addition, Haga et al. (2019) document the deliberate behavior of managers to reduce tax rate results in asymmetric cost behavior. Dierynck et al. (2012) find evidence of beating zero earnings benchmark and asymmetric cost behavior. Also, Hartlieb and Loy (2017) document the impact of income smoothing on asymmetric cost behavior. In contrast to earlier findings, however, Jab-Allha (2019) finds a negative relationship between asymmetric cost behavior and income smoothing for firms listed on the Egyptian stock exchange.

2.3. Asymmetric Cost Behavior and other Financial Indicators

Ownership structure could be an indicator of asymmetric cost behavior. Prabowo et al. (2018) find a significant difference in cost behavior in state-owned firms in comparison with non-state-owned firms. As the decision of retaining unused capacity is more likely to be taken in state-owned firms. Also, Holzhacker et al. (2015) find differences in cost behavior between profit and non-profit organizations. Moreover, many scholars investigate the impact of debt intensity on cost behavior. For instance, Dalla Via & Perego (2014) and Kato et al. (2021) find relationship between long-term liability and asymmetric cost behavior. In addition, a considerable amount of literature has linked financial accounting characteristics to asymmetric cost behavior. Banker et al. (2016) link accounting conservatism with sticky cost. Kama and Weiss (2013) investigate the relationship between meeting analysts forecasts accuracy and stickiness cost behavior. Table (1) gives a brief summary and critique of the main literature that discussed above.

Table 1. Summary of Literature Review

Author, Year	**Main Investigation**	**Main Results**
A. Main Determinants of Asymmetric Cost Behavior		
Anderson et al. (2003)	investigate the asymmetric behavior of SG&A cost	managers avoid adjustment costs by retaining unused capacity which leads to asymmetric cost behavior
Banker et al. (2013)	investigate the asymmetric behavior of labor cost	increase of adjustment costs for labor leads to asymmetric cost behavior
Banker et al. (2014) and Chen et al. (2019)	investigate the main determinants of asymmetric behavior	managers retain unused capacity during the periods of sales decrease since managers confidently expect increase sales in the future
B. Asymmetric Cost Behavior and Managerial Incentives		
Dierynck et al. (2012)	investigate the relationship between	find evidence of beating zero earnings benchmark and

	beating earnings benchmark and asymmetric cost behavior incentives behind	asymmetric cost behavior
Kama and Weiss (2012) and Chen et al. (2013)	investigate managers` incentives as a main determinant of asymmetric cost behavior	-opportunistic behavior of managers to meet earnings forecasts leads to asymmetric cost behavior. -managers with high level of optimism have high level of asymmetric cost behavior.
Haga et al. (2019)	investigate the relationship between reducing tax rate and asymmetric cost behavior	the deliberate behavior of managers to reduce tax rate results in asymmetric cost behavior
C. *Asymmetric Cost Behavior and other Financial Indicators*		
Holzhacker et al. (2015) and Prabowo et al. (2018)	investigate profit-oriented and ownership structure as an indictor of asymmetric cost behavior	- difference in cost behavior between profit and non-profit organizations - difference in cost behavior between state-owned and non-state-owned firms
Perego (2014) and Kato et al. (2021)	investigate debt intensity as an indicator of asymmetric cost behavior	Find significant relationship between long-term liability and asymmetric cost behavior

2.4. Research Gap and Hypotheses Development

The prior literature suggests that the main driver of asymmetric cost behavior is the managers` decision to retain unused capacity to avoid adjustment costs and to meet managers` positive expectation about future sales. Consequently, increasing capacity by adding new resources leads to increase asymmetric cost behavior. Therefore, investment intensity affects asymmetric cost behavior, typically through its influence on managers' decisions to retain unused capacity. However, little is known about investment intensity and its role in shaping cost structure. It is not clear what

the potential of asymmetric cost behavior by increasing investment capacity. This paper tries to understand how investment intensity (i.e., capital expenditure and net PPE investment) shapes cost structure (i.e., operating cost and SG&A cost). Since firms maintain investment in PPE regardless the periods of sales decrease. The amounts of investment in PPE capitalized to the assets in the balance sheet until the assets are ready to be used for the intended purpose. Then all subsequent ancillary costs would be expended in the income statement. These ancillary costs lead to the asymmetric cost behavior. Thus, the first hypothesis could be formulated as follows:

H_1*: Investments intensity increases the degree of asymmetric cost behavior in the current period.*

Shust and Weiss (2014) document the asymmetric cost behavior of operating cost. Therefore, increase in investment intensity increases asymmetric behavior of operating cost. Thus, first hypothesis could be subdivided into the following hypothesis:

H_{1a}*: Investments intensity increases the degree of asymmetric cost behavior of operating cost in the current period.*

Anderson et al. (2003) find evidence that the increase in SG&A for a given sales volume is higher than the decrease in SG&A cost for the same decrease in sales volume. This paper provides further investigation with SG&A cost to examine the impact of investment intensity on asymmetric cost behavior of SG&A cost. Thus, first hypothesis could be subdivided into the following hypothesis:

H_{1b}*: Investments intensity increases the degree of asymmetric cost behavior of SG&A cost in the current period.*

Prior studies of Lev & Thiagarajan (1993) and Kerstein & Kim (1995) document a positive market reaction towards announcement of increasing investment tensity (Wijayana and Achjari, 2020). Therefore, it is expected that investment intensity decreases the asymmetric cost behavior over time. This regression in asymmetric cost behavior may be explained by the fact that investment intensity would increase future sales. In addition to the fact

that most of the ancillary costs are transitory. This discussion leads to formulate the second hypothesis as the follows:

H_2: The lagged investment intensity decreases the asymmetric cost behavior in the current year.

This paper lies further than Shust and Weiss`s (2014) who document the asymmetric cost behavior of operating cost. As the level of asymmetric cost behavior of operating cost which results from investment intensity would be decreased in the next year. Therefore, the second hypothesis could be subdivided into the following hypothesis:

H_{2a}: The lagged investment intensity decreases the asymmetric cost behavior of operating cost in the current year.

Similarly, the level of asymmetric cost behavior of SG&A cost which results from investment intensity would be decreased in the next year. Therefore, the second hypothesis could be subdivided into the following hypothesis:

H_{2b}: The lagged investment intensity decreases the asymmetric cost behavior of SG&A cost in the current year.

The main objective of this study is to develop an understanding of the effect of investment intensity on asymmetric cost behavior. In addition, this study lies beyond prior literature in management accounting of studying asymmetric cost behavior (e.g., Anderson et al. 2003; Banker et al. 2014; Shust and Weiss 2014; Chen et al. 2019; Kim et al. 2019; Liu et al. 2019; Xu and Zhang 2020) by investigating the current and lagged effect of capital expenditure and PPE investments on asymmetric cost behavior. Thus the main objective could be subdivided into the following objectives:

- To investigating the effect of capital expenditure and PPE investments on the asymmetric behavior of operating cost.
- To investigating the effect of capital expenditure and PPE investments on the asymmetric behavior of SG&A cost.
- To examines the significance of lagged capital expenditure and PPE investments on decreasing the asymmetric behavior of operating cost.

- To examines the significance of lagged capital expenditure and PPE investments on decreasing the asymmetric behavior of SG&A cost.

Table (2) provides definitions of the main variables used in this study.

Table 2. Variables Definition

VARIABLE	DEFINITION	
GENERAL VARIABLE		
$\boldsymbol{Cap\_Exp_{i,t}}$	capital expenditures for firm i in year t	
$\boldsymbol{LogPPE_{i,t-1}}$	natural logarithm of net PPE for firm i in year t-1.	
$\boldsymbol{SALES_{i,t}}$	net sales revenue for firm i in year t	
$\boldsymbol{OI_{i,t}}$	operating income for firm i in year t	
$\boldsymbol{OC_{i,t}}$	operating cost for firm i in year t	= net sales - operating income
MODEL VARIABLE		
DEPENDENT VARIABLE		
$\boldsymbol{\Delta LogOC_{i,t}}$	change in operating cost for firm i in year t	= log $(OC_{i,t}/OC_{i,t-1})$
$\boldsymbol{\Delta LogSG\&A_{i,t}}$	change in SG&A for firm i in year t	= log (SG&A $_{i,t}$/ SG&A $_{i,t-1}$)
INDEPENDENT VARIABLES		
$\boldsymbol{\Delta logSALES_{i,t}}$	change in sales for firm i in year t	= log $(SALES_{i,t}/SALES_{i,t-1})$
$\mathbf{DEC_{i,t}}$	decrease in sales for firm i in year t in comparison to year t-1	= 1 if $sales_t < sales_{t-1}$
$\boldsymbol{Inv\_Ints_{i,t}}$	investment intensity for firm i in year t	=log [(capital expenditures$_t$ + net PPE$_{t-1}$)/SALES$_t$]

3. Data and Methodology

3.1. Data and Sample Selection

Hypotheses are tested using financial data obtained from listed firms and retrieved from Bloomberg database. The sample for this study includes all firms that are listed in the Egyptian Stock Exchange, over 12 years of the period from 2007 to 2018. Following prior studies (e.g., Kim et al. 2019; Liu et al. 2019; Golden et al. 2020; Xu and Zhang 2020; Hoglund et al., 2022) the initial sample is modified to reach the final one as following criterion. First: only firm-year observations with complete data for all study variables of baseline model are considered. Second: to avoid distortion and

incomparable results; firm-year observations with value of operating cost or SG&A cost exceed net sales are excluded from the final sample. Third: to mitigate the impact of outliers on the analysis and for each variable in this study the top and bottom 0.5 percent are removed. These modifications result in a final sample of 1,409 firm-year observations. Table (3) summaries selection criteria and table (4) provides descriptive statistics of the final sample.

Table 3. Selection of Data Sample

Selections Criteria	**Excluded observations**	**Remaining observations**
Initial sample	-	2,932
Excluding incomplete data for all study variables of baseline model	451	2,481
Excluding firm-year observations with value of operating cost or SG&A cost exceed net sales	8	2,473
Excluding the top and bottom 0.5 percent	1,064	1,409

Table 4. Descriptive Statistics

VARIABLE	**MEAN**	**STANDARD DEVIATION**	**MIN**	**25TH PERCENTILE**	**MEDIAN**	**75 PERCENTILE**	**MAX**
$\boldsymbol{\Delta LogOC_{i,t}}$	0.022	0.092	-0.374	-0.022	0.017	0.067	0.432
$\boldsymbol{\Delta LogSG\&A_{i,}}$	0.013	0.083	-0.170	-0.019	0.01	0.63	0.342
$\boldsymbol{\Delta logSALES_{i}}$	0.016	0.019	-0.256	-0.058	0.016	0.006	0.359
$\mathbf{DEC_{i,t}}$	0.371	0.481	0	0	0	1	1
$\boldsymbol{Inv\_Ints_{i,t}}$	0.251	0.251	0.101	0.108	0.185	0.307	0.745

The statistics obtained from table (4) can be compared to Anderson et al. (2003). The sample reveals similar statistics that the mean (median) of change in $LogSG\&A_{i,t}$ is 0.013 (0.01) and the mean (median) of change in $LogSALES_{i,t}$ is 0.016 (0.016). The variable of $Inv\_Ints_{i,t}$, which indicates the ratio of capital expenditures and net PPE investment to sales, has positive values of average and median of (0.251) and (0.185) respectively. These positive values indicate that all firms in the sample have capital expenditure and PPE investments. The variable $DEC_{i,t}$, which indicates decrease in sales for firm i in year t from the previous year, has average value of (0.371). This value indicates that 37.1% of the sample has a decrease in sales revenue. The average value of $DEC_{i,t}$of Anderson et al. (2003) is 17.45% which is lower by 20% than this sample. These differences can be explained in part by the fact that this sample includes periods of financial recession in the Egyptian market (e.g., the global financial crisis in 2008 and the unstable political situation in 2011).

3.2. Measurement and Methodology

This paper investigates the effect of investment intensity on the asymmetric cost behavior to test whether investment intensity increases the asymmetric cost behavior of operating cost and SG&A cost. Moreover, this study lies beyond this analysis by examining the lagged effect of investment intensity on the asymmetric cost behavior to indicate whether investment intensity in the previous year decreases the asymmetric cost behavior of operating cost and SG&A cost in the current year.

Measuring Investment Intensity

This study follows Hoglund et al. (2022) in measuring investment intensity which represents capital expenditures during year t plus natural logarithm of net PPE at year t-1 (the beginning balance of the current year) as the following formula:

$$Inv\_Ints_{i,t} = Cap\_Exp_{i,t} + LogPPE_{i,t-1} \quad (1)$$

Measuring Operating Cost

Following prior literature (Weiss, 2010; Balakrishnan et al., 2014; Cannon, 2014) operating cost is measured as the difference between net sales and operating income as the following formula:

$$OC_{i,t} = SALES_{i,t} - OI_{i,t} \quad (2)$$

Where: $OC_{i,t}$ refers to operating cost for firm i in year t, $SALES_{i,t}$ refers to net sales revenue for firm i in year t and $OI_{i,t}$ refers to income from operating for firm i in year t. The current sample is limited by firm-year observations of operating cost less than net sales.

Measuring Sales, General and Administrative Cost

The proxy of SG&A is prepared according to the procedure used by Anderson et al. (2003). $SG\&A_{i,t}$ is measured as selling, general, and administrative expenses reported for firm i in year t. Similar to operating cost the current sample is limited by firm-year observations of SG&A cost less than net sales.

4. Empirical Models

In most cost behavior studies, the asymmetric cost behavior has been measured in similar way (e.g., Anderson et al. 2003; Banker and Byzalov, 2014; Kama and Weiss, 2013; Shust and Weiss, 2014). This study uses Anderson et al. (2003) baseline model to measure the asymmetric cost behavior as the following formula:

$$\Delta LogSG\&A_{i,t} = \beta_0 + \beta_1 \Delta logSALES_{i,t} + \beta_2 DEC_{i,t} * \Delta logSALES_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where $\Delta LogSG\&A_{i,t}$ refers to change in natural logarithm of SG&A cost for firm i in year t (dependent variable), $\Delta logSALES_{i,t}$ refers to change in natural logarithm of sales for firm i in year t (independent variable) and $DEC_{i,t}$ refers to decrease in sales as a dummy variable which takes value of

1 if sales in the year t decrease in comparison with sales in the previous year t-1 and takes value of zero otherwise (independent variable). To measure asymmetric cost behavior Anderson et al. (2003) regress change in SG&A cost on change in sales.

This study aims to investigate the effect of investment intensity on the asymmetric cost behavior of operating cost and SG&A cost. It is expected that investment intensity increases the asymmetric cost behavior. To test H_{1a}this study extends model (3) (Anderson et al., 2003) by including investment intensity. The change in natural logarithm of operating cost for firm i in year t is regressed on change in natural logarithm of sales for firm i in year t. Then, investment intensity for firm i in year t is included to the baseline model (model 3) to test the effect of investment intensity on the asymmetric cost behavior of operating cost as the following formula:

$$\Delta LogOC_{i,t} = \beta_0 + \beta_1 \Delta logSALES_{i,t} + \beta_2 DEC_{i,t} * \Delta logSALES_{i,t} + \beta_3 DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t} + \varepsilon_{i,t} \quad (4)$$

Where $DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t}$ refers to the interaction between decrease in sales for firm i in year t, change in natural logarithm of sales for firm i in year t and capital expenditure and PPE investments for firm i in year t. It is expected that investment intensity increases asymmetric cost behavior of operating cost; therefore, β_3 at model (4) would be negative and significant.

Similarly, to testH_{1b}, change in natural logarithm of SG&A cost for firm i in year t is regressed on change in natural logarithm of sales for firm i in year t. Then, investment intensity for firm i in year t is included to the baseline model (model 3) to test the effect of investment intensity on the asymmetric cost behavior of SG&A cost as the following formula:

$$\Delta LogSG\&A_{i,t} = \beta_0 + \beta_1 \Delta logSALES_{i,t} + \beta_2 DEC_{i,t} * \Delta logSALES_{i,t} + \beta_3 DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t} + \varepsilon_{i,t} \quad (5)$$

It is expected that investment intensity increases asymmetric cost behavior of SG&A; therefore, β_3 at model (5) would be negative and significant.

Moreover, this paper contributes to management accounting literature that investigates the lagged effect of investment intensity on the asymmetric cost behavior. Investment intensity in year t-1 decreases the asymmetric cost behavior of operating cost and SG&A cost in year t. This expectation is examined through testing second hypothesis, thus previous models (model 4 and model 5) are developed to include the lagged effect of investment intensity. More specifically, to test H_{2a}, investment intensity in year t-1 is added to model (4) to test the lagged effect on the asymmetric cost behavior of operating cost in year t as the following formula:

$$\begin{aligned} \Delta LogOC_{i,t} = {} & \beta_0 + \beta_1 \Delta logSALES_{i,t} + \beta_2 DEC_{i,t} * \Delta logSALES_{i,t} \\ & + \beta_3 DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t} + \varepsilon_{i,t} \beta_4 DEC_{i,t} \\ & * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1} + \varepsilon_{i,t} \quad (6) \end{aligned}$$

Where $\beta_4 DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1}$ refers to the interaction between decrease in sales for firm i in year t, change in natural logarithm of sales for firm i in year t and capital expenditure and PPE investments for firm i in year t-1. It is expected that the lagged investment intensity (in year t-1) decreases asymmetric cost behavior of operating cost in year t, therefore β_4 at model (6) would be positive and significant.

Similarly, to test H_{2b}, investment intensity in year t-1 is included to model (5) to test the lagged effect on the asymmetric cost behavior of SG&A cost in year t as following formula:

$$\begin{aligned} & \Delta LogSG\&A_{i,t} \\ = {} & \beta_0 + \beta_1 \Delta logSALES_{i,t} + \beta_2 DEC_{i,t} * \Delta logSALES_{i,t} \\ & + \beta_3 DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t} + \varepsilon_{i,t} \beta_4 DEC_{i,t} \\ & * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1} + \varepsilon_{i,t} \quad (7) \end{aligned}$$

It is expected that the lagged investment intensity (in year t-1) decreases asymmetric cost behavior of SG&A in year t, therefore β_4 at model (7) would be positive and significant.

5. Empirical Results

Asymmetric Cost Behavior

The asymmetric cost behavior is checked initially when the baseline model (model 3) is run and then checked again to test first and second hypotheses. The main purpose of running the baseline model is to emphasis on the existence of asymmetric cost behavior in the sample to test hypotheses. It is apparent from table (5) that a positive correlation is found between Δsales and ΔSG&A cost. The coefficient estimate of β_1 is positive and significant of (0.592). This result indicates that for each 1 percent increase in sales results in a 0.592 percent increase in SG&A cost. The coefficient estimated of β_2, as expected and consistent with prior literature, is negative and significant of (-0.210). The combination of β_1 and β_2, indicates that for each 1 present decrease in sales results in a 0.382 (0.592 and -0.210) decrease in SG&A cost which indicates the asymmetric behavior of SG&A cost. The results obtained from the preliminary analysis of the baseline model highlight the asymmetric cost behavior of SG&A cost in the sample, which increases motivations for testing first and second hypotheses.

Table 5. Empirical Results for "*Asymmetric Cost Behavior-Baseline Model"*

INDEPENDENT VARIABLE		$\boldsymbol{\Delta LogSG\&A_{i,t}}$
INTERCEPT	β_0	0.006*** (0.001)
$\boldsymbol{\Delta logSALES_{i,t}}$	β_1	0.592*** (0.007)
$\boldsymbol{DEC_{i,t} * \Delta logSALES_{i,t}}$	β_2	-0.210*** (0.013)
N		1,409
ADJUSTED $\boldsymbol{R^2}$		0.383

* p<0.05, ** p<0.01, *** p<0.001

The Effect of Investment Intensity on Asymmetric Cost Behavior

The first set of analysis examines the asymmetric cost behavior. The results find evidence of asymmetric cost behavior of SG&A cost. In this set of analysis the investigation is expanded by investigating whether investment intensity increases asymmetric cost behavior. Table (6) presents the breakdown of testing first hypothesis according to models (4) and (5)

which indicates that β_3 is negative and significant. These results match the expectation that investment intensity increases the asymmetric cost behavior. As shown in panel A of table (6): β_3 is (*-0.657*) which indicates that the increase in investment intensity increases the asymmetric cost behavior of operating cost. Similarly, as shown in panel B of table (6), β_3 is (*-0.528*) which indicates that the increase in investment intensity increases the asymmetric cost behavior of SG&A cost. These results provide empirical support for the first hypothesis (H_1) that the degree of asymmetric cost behavior is increased by a firm's investment intensity.

Table 6. Empirical Results for H_1: "*The effect of firm's investment intensity on asymmetric cost behavior"*

PANEL A: OPERATING COST

INDEPENDENT VARIABLE		$\Delta LogOC_{i,t}$
INTERCEPT	β_0	0.005*** (0.001)
$\Delta logSALES_{i,t}$	β_1	0.589*** (0.007)
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	-0.082*** (0.015)
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv_{Ints_{i,t}}$	β_3	*-0.657**** *(0.038)*
N		*1,397*
ADJUSTED R^2		*0.412*

PANEL B: SG&A COST

INDEPENDENT VARIABLE		$\Delta LogSG\&A_{i,t}$
INTERCEPT	β_0	0.005*** (0.001)
$\Delta logSALES_{i,t}$	β_1	0.579*** (0.008)
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	-0.056*** (0.014)
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv_{Ints_{i,t}}$	β_3	*-0.528**** *(0.040)*
N		*1,355*
ADJUSTED R^2		*0.422*

* p<0.05, ** p<0.01, *** p<0.001

The Lagged Effect of Firm's Investment Intensity on Asymmetric Cost Behavior

This set of analysis provides additional evidence with the respect to asymmetric cost behavior. Second hypothesis states that investment intensity in year t-1 decreases the asymmetric cost behavior in year t. Table (7) presents the results obtained from the preliminary analysis of testing second hypothesis according to models (6) and (7). The results indicate that β_4 is negative and significant which do not match the expectations. However, to determine the lagged effects of investment intensity, it is encouraging to compare these results with that reported in table (6). As shown in panel A of table (6) and panel A of table (7): β_3 (model 4) and β_4 (model 6) decreases from (-0.657) to (-0.205) which indicates that investment intensity in year t-1 decreases the asymmetric behavior of operating cost in year t. Similarly, As shown in panel B of table (6) and panel B of table (7); β_3 (model 5) and β_4 (model 7) decreases from (-0.528) to (-0.190) which indicates that investment intensity in year t-1 decreases the asymmetric behavior of SG&A cost in year t. This analysis is quite revealing that the asymmetric cost behavior of operating cost and SG&A cost for the current year are less pronounced than the previous year (the lagged effect). These findings have important implications for studying asymmetric cost behavior in management accounting literature through providing empirical support for second hypothesis (H_2) that lagged firm's investment intensity decreases the asymmetric cost behavior.

Table 7. Empirical Results for H_2: "*The lagged effect of firm's investment intensity on asymmetric cost behavior***"**

PANEL A: OPERATING COST

INDEPENDENT VARIABLE		$\Delta LogOC_{i,t}$
INTERCEPT	β_0	0.004*** (0.001)
$\Delta logSALES_{i,t}$	β_1	0.564*** (0.008)
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	-0.069*** (0.014)
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t}$	β_3	*-0.399*** *(0.042)*
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1}$	β_4	*-0.205*** *(0.016)*
N		*1,397*
ADJUSTED R^2		*0.422*

PANEL B: SG&A COST

INDEPENDENT VARIABLE		$\Delta LogSG\&A_{i,t}$
INTERCEPT	β_0	0.004*** (0.001)
$\Delta logSALES_{i,t}$	β_1	0.556*** (0.008)
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	-0.042*** (0.016)
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t}$	β_3	*-0.393*** *(0.042)*
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1}$	β_4	*-0.190*** *(0.019)*
N		*1,355*
ADJUSTED R^2		*0.412*

* p<0.05, ** p<0.01, *** p<0.001

6. Robustness Test

This study confirms previous findings of asymmetric cost behavior and contributes additional evidence which suggests that the lagged effect of firm's investment intensity decreases the asymmetric cost behavior. A considerable amount of literature has been published on management accounting literature using the log approach to measure asymmetric cost behavior which is introduced by Anderson et al. (2003). However, such expositions are unsatisfactory as a result of that log approach is biased and reveals explicit asymmetric cost behavior (Hoglund et al., 2022). Thus, ratio approach offers a reliable way of measuring asymmetric cost behavior. Therefore, this section challenges the widely used approach "log approach" by providing additional tests using "ratio approach". The ratio approach indicates the percentage change in item which is the difference between current and lagged value over lagged value calculated as the following formula:

$$The\ percentage\ change\ in\ item = \frac{Current\ value - Lagged\ value}{Lagged\ value} \quad (8)$$

Although the ratio approach has successfully demonstrated the asymmetric cost behavior, it has certain limitations in terms of sensitivity to outliers. Following Hoglund et al. (2022) to mitigate the impact of outliers on the analysis and for continuous variables in this study the top and bottom 0.5 percent are removed. Ratio approach is synthesized using the same models (model 3 to model 7) which are detailed for log approach to measure asymmetric cost behavior. To see if the two approaches give the same measurement, the data was plotted and table (8) to table (10) provide results of using ratio approach. Starting with model (3), the coefficient estimated of β_2 is negative and significant of (-0.087), see table (8). The results assert the asymmetric cost behavior of SG&A cost in the sample.

Table 8. Empirical Results for Additional Test of "*Asymmetric Cost Behavior-Baseline Model"*

INDEPENDENT VARIABLE		$\Delta LogSG\&A_{i,t}$
INTERCEPT	β_0	0.003*** (0.001)
$\Delta logSALES_{i,t}$	β_1	0.527*** (0.008)
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	-0.087*** (0.015)
N		1,409
ADJUSTED R^2		0.381

* p<0.05, ** p<0.01, *** p<0.001

To investigate the effect of investment intensity on the degree of asymmetric cost behavior model (4) and model (5) are run using ratio approach. The results indicate that the coefficient estimated of β_3 is negative and significant of (-0.599) and (-0.370) respectively, see table (9). These results match those observed using the log approach that investment intensity increases the asymmetric cost behavior of operating cost and SG&A cost. Similarly, to test second hypothesis and indicate whether lagged investment intensity decreases asymmetric cost behavior model (6) and model (7) are run using ratio approach. The results indicate that the coefficient estimated of β_4 is negative and significant of (-0.177) and (-0.156) respectively, see table (10). However, this asymmetric cost behavior for the current year is less pronounced than the previous year (the lagged effect). The last set of analysis contributes to existing knowledge of asymmetric cost behavior by providing evidence about the lagged effect of firm's investment intensity which decreases asymmetric cost behavior. As shown in panel A of table (9) and panel A of table (10); β_4 decreases from (-0.599) to (-0.177) which indicates that the increase in investment intensity in year t-1 decreases the asymmetric cost behavior of operating cost in year t. These results match those observed using the log approach that investment intensity in the previous year decreases the asymmetric cost behavior in the current year.

The average coefficient estimates using log approach and ratio approach are compared to add reliability to this study. Interestingly, the results regarding the first and second hypotheses remain constant using the two approaches. However, the coefficients estimated using ratio approach have value less than what observed using log approach. An example of this: β_2 of the baseline model has value of (-0.210) using log approach and has value of (-0.087) using ratio approach. These results are supported by Hoglund et al. (2022) who argue that ratio approach offers a reliable way of measuring asymmetric cost behavior.

Table 9. Empirical Results for Additional Test of: "*The effect of firm's investment intensity on asymmetric cost behavior"*

PANEL A: OPERATING COST

INDEPENDENT VARIABLE		$\boldsymbol{\Delta LogOC_{i,t}}$
INTERCEPT	β_0	0.026*** *(0.001)*
$\boldsymbol{\Delta logSALES_{i,t}}$	β_1	*0.536*** *(0.008)*
$\boldsymbol{DEC_{i,t} * \Delta logSALES_{i,t}}$	β_2	*-0.073*** *(0.013)*
$\boldsymbol{DEC_{i,t} * \Delta logSALES_{i,t} * Inv_{Ints_{i,t}}}$	β_3	*-0.599*** *(0.035)*
N		*1,397*
ADJUSTED $\boldsymbol{R^2}$		*0.408*

PANEL B: SG&A COST

INDEPENDENT VARIABLE		$\boldsymbol{\Delta LogSG\&A_{i,t}}$
INTERCEPT	β_0	0.026*** *(0.001)*
$\boldsymbol{\Delta logSALES_{i,t}}$	β_1	*0.532*** *(0.008)*
$\boldsymbol{DEC_{i,t} * \Delta logSALES_{i,t}}$	β_2	*-0.036*** *(0.011)*
$\boldsymbol{DEC_{i,t} * \Delta logSALES_{i,t} * Inv_{Ints_{i,t}}}$	β_3	*-0.370*** *(0.037)*
N		*1,355*
ADJUSTED $\boldsymbol{R^2}$		*0.396*

* p<0.05, ** p<0.01, *** p<0.001

Table 10. Empirical Results for Additional Test of: "*The lagged effect of firm's investment intensity on asymmetric cost behavior"*

PANEL A: OPERATING COST

INDEPENDENT VARIABLE		$\Delta LogOC_{i,t}$
INTERCEPT	β_0	0.025*** *(0.001)*
$\Delta logSALES_{i,t}$	β_1	*0.531*** *(0.009)*
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	*-0.049** *(0.011)*
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t}$	β_3	*-0.341*** *(0.033)*
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1}$	β_4	*-0.177** *(0.015)*
N		*1,397*
ADJUSTED R^2		*0.392*

PANEL B: SG&A COST

INDEPENDENT VARIABLE		$\Delta LogSG\&A_{i,t}$
INTERCEPT	β_0	0.025*** *(0.001)*
$\Delta logSALES_{i,t}$	β_1	*0.529*** *(0.008)*
$DEC_{i,t} * \Delta logSALES_{i,t}$	β_2	*-0.052**** *(0.012)*
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t}$	β_3	*-0.335**** *(0.033)*
$DEC_{i,t} * \Delta logSALES_{i,t} * Inv\_Ints_{i,t-1}$	β_4	*-0.156** *(0.015)*
N		*1,355*
ADJUSTED R^2		*0.408*

* p<0.05, ** p<0.01, *** p<0.001

7. Discussion

- The main objective of this study is to investigate how investment intensity affects asymmetric cost behavior in emerging context, Egypt. The empirical results indicate the main following findings:
    - The asymmetric cost behavior of operating cost and SG&A cost is increased by capital expenditure and PPE investments.
    - A possible explanation for these results may be due to the ancillary cost which generates when assets are used.
- Further analysis of this study assesses the long-term effect of investment intensity on asymmetric cost behavior. The empirical results show the main following findings:
    - The lagged investment intensity decreases the asymmetric cost behavior of operating cost and SG&A cost.
    - A possible explanation for these results may be the fact that most of the ancillary cost is transitory and reduced overtime.
- The robustness test confirms empirical findings and contributes additional evidence using ratio approach which offers a reliable way of measuring asymmetric cost behavior. The results of ratio approach assert the following findings:
    - Asymmetric cost behavior of SG&A cost is detected in the sample.
    - Results match those observed using the log approach that:

8. Future Research

Further investigations encourage future research to enhance the understanding of cost behavior and its role in shaping firms' cost structures. Therefore, there is abundant room for further progress could be highlighted in the following points:

- Conducting comparative study of cost behavior at different stages of firm`s life cycle.
- Investigating the effect of different types of determinants on cost behavior, for example; managerial opportunistic behavior through earnings management.

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المستخلص:

الغرض - تتفاعل التكلفة بطريقة غير متماثلة للتغير فى حجم محرك التكلفة وعلى هذا، تهدف هذه الدراسة إلى معرفة كيفية تأثير حجم الاستثمار على السلوك غير المتماثل للتكلفة. حيث تم دراسة تأثير الإنفاق الرأسمالي على السلوك غير المتماثل للتكلفة بالتطبيق على تكلفة التشغيل والتكاليف البيعية والعمومية والادارية. بالإضافة إلى ذلك، تضيف هذه الدراسة الى الأدبيات السابقة فى مجال محاسبة التكاليف من خلال فحص تأثير حجم الاستثمار فى الفترات السابقه على السلوك غير المتماثل للتكلفة.

المنهجية - تعتمد هذه الدراسة بصفة اساسية على نموذج Anderson et al. (2003) لقياس السلوك غير المتماثل للتكلفة بالتطبيق على تكلفة التشغيل والتكاليف البيعية والعمومية والادارية. بالإضافة إلى ذلك، تم تطوير ذلك النموذج ليتضمن حجم الانفاق الرأسمالى، وذلك لقياس تأثيره على السلوك غير المتماثل للتكلفة.

النتائج – كشفت نتائج الدراسة عما يلى: 1) يعمل الانفاق الرأسمالى على زيادة السلوك غير المتماثل لتكلفة التشغيل والتكاليف البيعية والعمومية والادارية. 2) يحد حجم الانفاق الرأسمالى فى الفترات السابقه من السلوك غير المتماثل للتكلفة فى الفترات المستقبليه. 3) انخفاض السلوك غير المتماثل للتكلفة في الاجل الطويل.

حدود البحث – تقتصر هذة الدراسة على تحليل تأثير حجم الاستثمار الرأسمالى على السلوك غير المتماثل للتكلفة لمدة عام واحد فقط ولا تستعرض التأثير على دورة حياة الشركة. وبذلك توصى الدراسة باجراء أبحاث مستقبلية لمقارنة سلوك التكلفة في مراحل مختلفة من دورة حياة الشركة.

التطبيقات العملية - أحد اهم التطبيقات العملية لهذه الدراسة هو تعزيز فهم السلوك غير المتماثل للتكلفة و تأثيرات حجم الاستثمار عليه وانعكاسات ذلك على نماذج التكلفة وصنع القرارات الإدارية.

الأصالة – تضيف هذه الدراسة إلى أدبيات المحاسبة الإدارية من خلال تقديم دليل على أن حجم الاستثمار محدد رئيس للسلوك غير المتماثل للتكلفة. بالإضافة إلى ذلك، فإن تأثير حجم الاستثمار على السلوك غير المتماثل للتكلفة هو تأثير مؤقت وينخفض في الاجل الطويل.

الكلمات المفتاحيه - السلوك غير المتماثل للتكلفة؛ تكلفة التشغيل؛ التكاليف البيعية والعمومية والادارية؛ حجم الاستثمار؛ الانفاق الرأسمالي.