

## ARTICLE

## A Tool for Managerial Decision Making in Emerging Economies, and Asymmetric Cost Behavior: Evidence from Ecuador

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### ABSTRACT

Business sectors may be affected by changes in their activity levels. For this reason, the administration requires tools that allow to show the impact on its profitability. The asymmetry in the behavior of the costs of companies belonging to the economic sectors of beverage production and meat processing in Ecuador for the period between 2012 and 2018 was analyzed. 291 companies that presented activity were studied. For the study of sticky costs, 3 analysis variables were defined: operational income, total costs and expenses, and personnel costs and expenses; to which, four different study techniques were applied. The different analysis techniques show consistent and robust results, with the exception of the estimation using panel data in the meat sector. The study's results show an asymmetric behavior within the costs, which suggest an inability for Ecuadorian companies to lower their costs due to a drop on their income, whereas, when their income raises, so does their cost; a fact that matches the recent evidence found worldwide. This asymmetry could be explained by factors such as regulatory rigidity or expectations of a quick business recovery.

### KEYWORDS

Cost Asymmetry, Sticky Costs, Cost Behavior, Administration, Business Sectors

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Received: 01/29/2021.  
Revised: 06/06/2022.  
Accepted: 08/10/2022.  
Published: 06/15/2023.  
DOI: <https://doi.org/10.15728/bbr.2021.1170.en>



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The speed of information caused by globalization and accelerated business dynamics generates an important stream of competitiveness that requires constant monitoring and management of the costs involved in business operations, its prediction and forecasts understood as a determinant of perceived profits by a company, (Banker & Byzalov, 2014); which are also substantial for its efficient operation.

Timely and accurate financial information will probably lead to effective decision-making and thus offer support for the objectives and goals set (Chavéz & Vallejo, 2017). Cost accounting analyzes the financial information concerning the outlays of money for the manufacture, acquisition of products or to provide a service, classifying them between fixed and variable costs; and maintaining a symmetry between costs and income (Horngren et al., 2012). However, this traditional theory has been debated in recent years through research that shows asymmetry in the face of the variation of income and costs in different sectors and contexts. That is, the 1% increase in revenue brings with it an increase in costs and subsequently causes a contraction in revenue, therefore, costs are not reduced to the same extent, a fact that shows the difficulty of companies to contract their volume of expenses.

The work of Malcom (1991) was one of the first to introduce the concept of asymmetric costs, defined as the reduction of costs in periods of reduced sales as proportionally less compared to the increase in costs in periods of increased sales. However, it was not until Anderson et al. (2003) that they concluded on the existence of stickiness in the general and administrative costs of sales of a group of more than 7000 companies with a longitudinal scope of 20 years of study, by means of the creation of a logarithmic linear model in which the variation of costs could be verified in the face of a variation in income. This model was a pioneer on the subject and has been used since then by researchers in order to corroborate the existence or not of asymmetry in company costs.

Research on “sticky costs” that have been carried out in recent years (Da Silva et al., 2019; Freitas et al., 2019; Martínez et al., 2020; Matioli et al., 2019) have taken advantage of the ABJ model proposed by Anderson et al. (2003) and they have managed to show the asymmetry caused by business operations in various contexts.

However, there is a debate about the generalization of cost asymmetry behavior (Dalla & Perego, 2014) due to the diversity of conditions that can infer on it. Currently, multiple study methods and perspectives have been documented such as: the use of variables determining cost asymmetry (Kama & Weiss, 2013; Cannon, 2014), globalization that causes volatility in the behavior of emerging markets (Benachenhou, 2013) and macroeconomic variables linked to cost asymmetry (Abu-Serdaneh, 2014) that interact unevenly in different economies. Others have attempted to link their behavior to deliberate decisions and expectations of managers (Chen et al., 2015). There are studies that have focused their analysis on the validation of hypotheses about the existence of asymmetry (Medeiros et al., 2005). A large part of these studies determines the importance of the context in which the phenomenon is analyzed and specifies the need to pay special attention to the probity and reliability of the methods used. The shortcomings in the use of data analysis instruments may give results that do not necessarily define the behavior of costs in business segments.

This manuscript researches the asymmetric cost behavior of the Ecuadorian manufacturing industry since it represents more than 20% of national sales and salaries (Camino-Mogro et al., 2020). Furthermore, manufacturing businesses face a constant increase in global demand caused

by population growth, which is a strong determinant of this industry's analysis. Within this industry, four subsectors were studied as a result of managers' concern to understand their direct competitors' behavior rather than the macro-sector's, due to the fact that each subsector has different features and the decision-making responds to diverse critical factors (Superintendencia de Compañías Valores y Seguros del Ecuador, 2018).

A gap was identified in the literature between research of this type in developed economies versus emerging economies. We followed Banker and Byzalov (2014) who expose the focus of these studies on developed economies, mainly the United States, where the theory of asymmetric costs remains. Emerging economies experience a different background and circumstances to those encountered on developed economies; however, due to the lack of reliable information, enterprises are forced to base their decisions on the current theory (Groeneveld et al., 2017). It is imperative to confirm or deny the sticky cost behavior theory in Ecuadorian companies, this way decision makers are able to forecast the results of the applied strategies through economic models.

Therefore, this paper contributes to the literature by testing the general theory of cost asymmetry in emerging economies through empirical evidence that makes it possible to establish precisely and reliably the behavior of costs in countries with characteristics and limitations that are far from those presented by developed economies. This evidence enables companies to estimate cost modifications caused by demand fluctuations and avoid a vulnerability towards changes induced by the economic cycle and the macroeconomic environment, phenomena which promote an impulsive behavior on firms and ends up exposing them to the undesired effects of cost stickiness.

Furthermore, the research enriches literature and becomes original by studying a dollarized economy, which is not inclined to have abrupt variations on interest rate or inflation as a result of the nonexistent monetary policy. In emerging economies, particularly in Ecuador, access to technology is reduced, compared to developed countries; this technological gap is intensified by the absence of monetary policy, which is a condition for private investment, and with it, the capital acquisition remains limited, and the companies' cost strategies are forced to rely on their workforce. These features aggravate the businesses' sensitivity to asymmetric cost behavior and its consequences. The reason for this is, that to determine its existence has relevant connotations on the evaluation of investment, commercial, and human talent policies, which can be modified in order to counteract the exposure to the cost structure's sticky behavior.

An additional contribution of this paper is found in the analysis and testing of the asymmetric cost behavior theory through statistical techniques. It is intended to demonstrate useful results to promote efficiency in managerial decision-making, which emerges from the analysis and determination of the behavior of costs and their effects (Abu-Serdaneh, 2014).

In this sense, Balakrishnan et al. (2014) discusses the limitations and validity of several empirical results on cost asymmetry, questioning the methods used and their lack of rigor. Faced with the growing dispute over the correct determination of cost asymmetry, this manuscript seeks to provide reliability and robustness to the determination of asymmetric cost behavior by applying techniques that allow for analyzing the homogeneity of the results and the fulfillment of the proposed hypothesis. The application of several statistical tests encourages robustness through uncertainty reduction, which is achieved by analyzing if the results obtained are homogeneous and if the hypothesis is constant in spite of the method used, the author's subjectivity, or theory's assumptions fulfillment.

According to the previous background information, the research question posed is, do Ecuadorian firms from the beverage production and meat processing industries show cost stickiness?

Thus, the purpose of this study is to determine the asymmetry of costs in companies belonging to the economic sectors of beverage production and meat processing in Ecuador, focused on generating added value in the companies contemplated in the scope of this research through reliable information that enables an improvement in their decision-making. It should also be considered that this issue has been scarcely investigated in Ecuadorian companies, despite its usefulness in promoting the maximization of the income obtained by firms.

The structure of the research presents a section of theoretical guidelines and literature review, and then focus on detailing the methodology used for the analysis of the information. Next, the results obtained for the business sectors described are presented and the discussion regarding the literary guide, finally the conclusions are established.

## 2. LITERATURE REVIEW

### 2.1. COST ASYMMETRY: A CURRENT ISSUE

The managerial function is a fundamental axis in the results achieved by companies and is in charge of selecting the best course among various existing alternatives (Koontz et al., 2012). The information is the raw material on which managers decide; for this reason, the management of costs and expenses from the different areas of a company should be configured as a transcendental axis to improve the competitiveness of the firm.

The traditional cost literature classifies costs as fixed and variable, following a symmetry between the level of activity and costs (Hornngren et al., 2012). However, in recent decades this theory of symmetry has been questioned, because authors such as Noreen (1991) concluded that this is not a general rule. For this reason, the need to investigate in this regard has been strengthened and it seeks to analyze the behavior of the financial statements through empirical evidence of different types of companies.

Chen et al. (2015) justify cost asymmetry around deliberate decisions by managers that, in the face of a decrease in their income, allow themselves to maintain costs by assuming that such impact is temporary. Part of the literature supports this approach, by ensuring that the cost adjustment, after an increase or decrease in income, involves the intention of minimizing the costs caused by certain adjustment for the company. That is, costs of uninstalling and installing of equipment, and unrelated labor. It must be hired again once the demand recovers.

One of the first investigations on the subject was that of Noreen and Soderstrom (1997), with the objective of corroborating what Malcom (1991) had established years ago. However, their results were not effective enough to prove his hypothesis. Years later, Anderson et al. (2003) observed that the costs did not comply with the traditional theory. These results prompted an alternative approach to cost analysis called the "ABJ model". As a conclusion, they established that there are sticky costs when the increase in costs due to the increase in income is greater than when there is a decrease in costs due to their fall. This logarithmic regression model would be established as the basis for research on this topic today.

Several authors have tried to replicate this type of research in various contexts, generally with companies listed on the stock exchange, such as: Pamplona et al. (2016) in Brazil, Chile and Mexico; Zonatto et al. (2018) in countries of the BRICS group, (Brazil, Russia, China and

South Africa, India was not taken into account due to lack of data); also Pamplona et al. (2018) in countries of the PIIGS group (Portugal, Italy, Ireland, Greece and Spain). In addition, there is the study by Freitas et al. (2019) on the G-20 group of countries. Finally, Vieira et al. (2014) investigated the behavior of costs in companies from Argentina, Brazil, Colombia, Chile, Costa Rica, Jamaica, Mexico, Peru and Venezuela. All these authors confirmed the presence of sticky costs with different scopes and levels when estimating the ABJ model.

Researchers such as Coyne (2016) or Balakrishnan et al. (2014) maintain their questioning about the methods used in research related to sticky costs, due to specification problems in the models, lack of rigor, and limitations in the conclusions generated. Therefore, the phenomenon is in the midst of continuous refinement. As such, this paper aims to contribute to the robustness of estimation techniques by decreasing unpredictability on the cost behavior in the country, and on beverage and meat industries specifically.

Considering that the decisions to contract or increase costs go through a considerable number of determining factors and the managerial expectations of current and future demand, the cost asymmetry will be conditioned to the occurrence of possible events that are likely to impact the level of asymmetry achieved. (Chen et al., 2015).

Understanding the cost structure will be essential in considering the potential impact on earnings (Chen et al., 2015), which is why they are mandatory for managers, investors, and stakeholders related to business management.

## 2.2. DETERMINANTS OF COST ASYMMETRY: A LITERARY AND EMPIRICAL APPROACH

Since there is abundant statistical evidence on asymmetry in costs and a considerable increase in research on the subject, the lines of study have shown an interesting expansion that has strengthened the results obtained from multiple analyzes. For this reason, several researchers have tried to find the determinants of cost asymmetry and the factors that allow generating a better analytical approach on the subject of study. The variables conceived from the initial studies such as managerial expectations have been strongly analyzed, however, they are only a part of the literature since the impact of various types of variables have been concluded as financial variables that will serve as an instrument to take decisions on the rigidity of costs or variables related to the available amount of resources in a company that limit acting on acquired costs (Cannon, 2014).

Nassirzadeh et al. (2013) showed that costs tend to be sticky due to the size of the company and/or the control that is structured within the firms. Banker and Byzalov (2014) established that an important variable in the stickiness of costs is the period of time, their research showed that the longer the periods of analysis, the less stickiness you will find; in addition to exposing the premise about the existence of semi-fixed costs.

Ribeiro et al. (2005) study presented that a key point for addressing this issue is the rigidity in the labor laws of the countries. This is consistent with the alternative theory proposed by Anderson et al. (2003) in previous years. However, by including lags in his model of more than two years, the asymmetry tends to decrease as the lags increase, a method not shared by Anderson himself.

Banker et al. (2016) and Stimolo and Díaz (2017) consider the differentiation between sectors. They suggest not considering companies in the financial sector, since the financial statements of this industry have a different exposure regime. Despite this, Richartz and Borgert (2014) present evidence of asymmetric behavior in the costs of the Argentine financial sector, as well as Porporato and Werbin (2012) using the ABJ model in the banking sector.

The type of asymmetric cost is investigated by Dalla and Perego (2014) when comparing the costs between small and medium-sized companies in different sectors and seeing how they behave. In manufacturing companies, the authors found that only in labor costs is there asymmetric behavior. As for commercial companies, a case similar to manufacturing companies is presented, since the only cost that is asymmetrical is that of labor. In listed companies, they presented a greater asymmetry in costs, sales, and administration costs, as well as operating costs and labor costs showed a lower decrease as when they increased.

Subramaniam and Watson (2016) obtained that, in manufacturing, service, and financial companies, evidence was found that confirms the existence of cost asymmetry; while in marketing companies the existence of symmetry was confirmed.

In Ecuador, we find the study carried out by Cagigal and Petrovic (2017) which took 62,412 Ecuadorian companies with data from 2009 to 2013, finding that when sales increase by 1%, variable costs increase by 1.012%, while at decrease, they do so by 1.11%. This indicates that the variable costs do not present asymmetry. When estimating the model with sales and administration expenses, they obtained that if sales increase by 1%, expenses increase by 0.689%, but if sales decrease, expenses fall by 0.511%, thus confirming the sticky costs theory in administration and sales expenses. Also, there is an article by Cordova et al. (2018) that investigated the variation of costs in 381 companies in the construction sector in Ecuador from 2012 to 2015. It was found that Ecuadorian companies increase their expenses by 0.94% when their sales increase by 1% and decrease their costs by 0.30% when sales decrease in the same proportion, which confirmed the asymmetry of costs in this economic sector.

In this context, cost asymmetry is approached from various perspectives that obey the multiple sources of research and try to conclude in a deep and well-founded way the determinants that should be considered when generating an analysis on the subject, which are undoubtedly substantial contributions for this study.

Nevertheless, the studies done in Ecuador do not emphasize their focus on the significance of the results, which manifest a research gap, according to Balakrishnan et al. (2014).

Based on the aforementioned, the following hypothesis are presented:

- **H0:** The analyzed companies do not show an asymmetric behavior of their total costs and expenses, and in their personnel costs and expenses, in the face of a variation in their operating income.
- **H1:** The analyzed companies show an asymmetric behavior of their total costs and expenses, and in their personnel costs and expenses, in the face of a variation in their operating income.

### 3. METHODOLOGY

The study population was considered to be the companies classified as companies that have the obligation to report annually their financial statements to the Superintendency of Companies, Securities and Insurance of Ecuador, belong to the meat and beverage manufacturing sectors and have presented activity during the analysis period. The financial information of the companies was used and categorized according to the International Standard Industrial Classification ISIC4, considering C1010 meat processing and ISIC C11 beverage processing.

Table 1 presents the composition of the study unit. It has a total of 291 companies, of which 117 belong to the meat processing sector and 174 to the beverage production sector. To determine the firms that make up the unit of analysis, all active companies in the sectors studied were considered, with the exception of those who have not reported financial information for at least two consecutive periods. This was due to the fact that this makes it impossible to calculate year-on-year variations in the variables. The sectors studied were selected based on their significant participation within the Ecuadorian manufacturing sector in the areas of sales, utility, number of companies, total assets, and the number of employed personnel (Duque et al., 2020). The firms were classified according to the year-on-year variation in sales. Business grouped, on the one hand, the companies that showed a growing behavior in their operating income and, on the other hand, the companies that showed a decrease in these values. Due to the characteristic of the methodology, the information for 2012 is used only to obtain the variation with the subsequent year.

**Table 1**  
*Composition of the studied population*

Year	Sales growth		Sales decrease		Active companies	
	Meats	Beverages	Meats	Beverages	Meats	Beverages
2013	43	45	16	43	59	88
2014	45	56	19	34	64	90
2015	36	54	30	37	66	91
2016	30	47	36	43	66	90
2017	45	53	21	30	66	83
2018	39	52	22	29	61	81
Total active companies					117	174

*Source:* Authors' own elaboration.

Three quantitative variables were used to carry out the research: operating income, total costs and expenses, and personnel costs and expenses. The purpose was to show the interannual changes of the variables in real terms, these were deflated under the following considerations: the consumer price index of the Ecuadorian economy was used as a deflator in terms of operating income and the index of consumer prices for variables related to costs and expenses. Both indices were obtained from the monthly macroeconomic information published by the Instituto Nacional de Estadísticas y Censos (2020). The treatment of the metrics was in accordance with what was stated by Cerquera et al. (2018), Quinde and Bucaram (2017), Khan et al. (2018) and Topuz et al. (2018) regarding the bidirectional relationship of causality between the producer price index and the consumer price index. The authors suggest carrying out an independent treatment of the variables at the time of deflation.

An analysis of the atypical data presented in the database was performed using the Winsor method in a proportion of 2.5% in each tail of the distribution. In this way, the incidence of extreme values is reduced and data that may be representative is not discarded. (Deledalle & Rowe, 2020)

Among the studies performed on the variables, to establish the possibility of asymmetric costs, there was: elasticities, multivariable models, the ABJ model suggested by Anderson et al. (2003), and the estimation of the ABJ model using panel data regressions, which were done in order to provide robustness to the model.

The elasticity of total costs and expenses was evaluated as a first measure of asymmetry and personnel costs and expenses as a measure of sensitivity to changes in operating income in periods of growth and decrease in sales. The higher the elasticity value, the more sensitive will be the reaction of the analyzed variable to the change in another variable (Graue et al. 2006; Pindyck & Rubinfeld, 2009; Parkin and Loría, 2010; Martin et al. 2012).

The second measure of asymmetry was performed using estimation by ordinary least squares (OLS), a method used in the research carried out by Lewis (2011) and Uy, (2011), of a linear regression model for two study groups in each economic sector, the firms that presented interannual growth in their sales, and those that presented an interannual decrease in their values.

$$\text{Total Costs and Expenses} = \beta_0 + \beta_1 (\text{Sales}) \quad (1)$$

As a third measure of asymmetry, the ABJ regression model was estimated using OLS, proposed by Anderson et al., (2003) and replicated in the studies by Balakrishnan and Gruca (2008) and Zonatto et al. (2018), which indicated the presence and level of asymmetry in costs both in the meat processing sector and in the beverage sector.

$$\text{Total Costs and Expenses} = \beta_0 + \beta_1 \ln (\text{Sales}) \quad (2)$$

Finally, as a fourth measure of asymmetry, the ABJ model was estimated using panel data regressions with fixed and random effects models, as proposed by Stimolo and Díaz (2017). The Chi-squared test proposed by Hausman, (1978) was also performed in order to identify statistically significant differences between the fixed and random effects models.

$$\text{Total Costs and Expenses} = \beta_0 + \beta_1 \ln (\text{Sales}) + \beta_2 \text{dummy} (\text{Sales}) \quad (3)$$

#### 4. RESULTS AND DISCUSSION

The results obtained by the proposed models are presented in order to evaluate the existence of cost asymmetry in the economic sectors of meat processing and beverage production in Ecuador between 2013 and 2018.

Table 2 shows the descriptive statistical data of the two economic sectors analyzed. 905 observations corresponding to the two analysis units were studied, 382 from the meat sector and 523 from the beverage sector. It is evident that the meat sector, despite being made up of a smaller number of companies, has a higher economic dimension than the beverage sector. This situation occurs in the three variables studied and in the two measures of central tendency. In addition, there is evidence of a dispersion in the data that corresponds to the divergence of the economic and financial situation of the companies in relation to their size.

At first instance, an analysis of elasticities was carried out both in the meat processing sector and in the beverage production sector. The variations presented in sales, in total costs and expenses, and in personnel costs and expenses, in periods of growth and decreases in sales were calculated.

**Table 2**  
*Descriptive statistics of the meat and beverage sectors, 2013 - 2018*

		Operating Income	Total costs and expenses	Personnel costs and expenses
<b>Meat</b>				
Frequency		382	382	382
Mean		7.030.210,61	6.612.712,02	1.063.888,21
Median		1.336.891,09	1.327.377,84	169.089,80
Standard deviation		13.523.205,26	12.533.529,48	2.274.952,69
Percentiles	25	201.708,33	231.187,15	25.054,88
	50	1.336.891,09	1.327.377,84	169.089,80
	75	5.150.707,76	4.945.138,03	824.558,23
<b>Beverages</b>				
Frequency		523	523	523
Mean		4.393.488,95	4.323.630,58	684.624,80
Median		262.360,89	309.139,41	64.543,69
Standard deviation		13.854.336,17	13.387.563,77	1.902.631,43
Percentiles	25	42.637,39	51.462,88	13.113,50
	50	262.360,89	309.139,41	64.543,69
	75	1.495.762,30	1.470.008,40	354.303,56

*Source:* Authors' own elaboration.

Table 3 shows that in the meat processing sector, given a growth in sales of 1%, costs and expenses in total increase 0.96%. However, these expenditures only decrease 0.28% when income falls in the same proportion. Regarding personnel costs and expenses, it was found that when sales increase 1%, the costs that companies allocate on personnel increase 0.67%, although when sales decrease 1% the resources allocated to personnel only decrease 0.10%.

**Table 3**  
*Elasticities of the meat and beverage sectors, 2013 - 2018*

	Sales growth		Sales decrease	
	Percentage change	Elasticity	Percentage change	Elasticity
<b>Meat</b>				
Sales	13,30%	100,00%	-14,82%	100,00%
Total Costs and Expenses	12,78%	96,03%	-4,16%	28,09%
Personnel Costs and Expenses	8,90%	66,90%	-1,50%	10,11%
<b>Beverages</b>				
Sales	7,78%	100,00%	-32,51%	100,00%
Total Costs and Expenses	3,84%	49,38%	-8,45%	26,01%
Personnel Costs and Expenses	4,93%	63,41%	-5,47%	16,84%

*Source:* Authors' own elaboration.

Regarding the beverage manufacturing sector, Table 3 shows that when there is a 1% increase in sales, total costs and expenses increase by 0.49%. With a decrease in sales of equal value, costs and expenses decrease only 0.26%. When analyzing personnel expenses, it was observed that when income increased by 1%, this variable presented an increase of 0.63% and when income fell, personnel expenses decreased by 0.17%.

The results of the elasticity analysis show cost asymmetry in both sectors studied with respect to costs and expenses and personnel expenses. This was due to the fact that the response sensitivity of these variables to growth in sales is greater than the sensitivity presented to decreases in this variable, which indicates that costs are expanding faster than they are contracting in relation to variations in income.

After analyzing the elasticities, a linear regression model was performed using ordinary least squares in which the dependent variable is costs and expenses, explained by sales. This model was estimated in periods of growth and decrease in sales both in the meat processing sector and in the beverage production sector.

Table 4 shows that in the meat processing sector, with increases of one dollar in sales, costs and expenses increase by 0.92 dollars. But when revenues drop by one dollar, costs and expenses drop as low as 0.16 dollars. Regarding the beverage manufacturing sector, it is observed that for every dollar in which income increases, costs and expenses increase by 0.96 dollars. However, when sales decrease by one dollar, costs and expenses are reduced by 0.13 dollars. These results corroborate the existence of cost asymmetry in both sectors studied since the reduction of costs and expenses in periods of decrease in sales is significantly lower than the increase of these in periods of growth, which represent only 17.79% and 13.42% of the increase presented before a growth in sales in the meat and beverages sector respectively.

**Table 4**

*Statistical data of the linear regression model of the meat and beverage sectors, 2013 - 2018*

	Sales growth				Sales decrease			
	$\beta$	Standard error	t	P	B	Standard error	t	p
Meat								
Constant	117.865,73	57.891,34	2,04	0,042	- 91.794,39	27.905,98	- 3,29	0,001
Sales	0,92	0,00	242,98	0,000	0,16	0,00	89,69	0,000
R <sup>2</sup>	0,99				0,95			
Beverages								
Constant	127.513,27	93.462,51	1,36	0,173	121.569,98	31.398,57	3,87	0,000
Sales	0,96	0,01	148,39	0,000	0,13	0,00	59,27	0,000
R <sup>2</sup>	0,98				0,87			

*Source:* Authors' own elaboration.

The estimation was carried out using ordinary least squares of the ABJ model proposed by Anderson et al. (2003) in order to show the possible presence of asymmetry in costs and expenses in the face of variations in the income of each of the sectors. As previously described, this consists of a logarithmic model whose dependent variable is sales, explained by the natural logarithm of the interannual difference in sales and the decrease in sales and by means of a dummy variable

that takes values of one when the sales of a company show decreases from one year to another and values of zero when there are increases in sales. This makes it possible to individually identify the effect of increasing and decreasing sales on the company's costs and expenses. On the other hand, when income grows, the effect of B2 is eliminated and in this way only growth in income can be analyzed.

It can be seen in Table 5 that in the meat processing sector, with sales increases of 1%, costs and expenses grow 0.89%. When revenues fall 1%, costs and expenses do not behave in the same way, since they decrease 0.69%. This causes a difference of 0.20% in the behavior of costs and expenses, which indicates the existence of a cost asymmetry in the meat sector of Ecuador.

**Table 5**

*Statistical data of the ABJ model through linear regression of the meat and beverage sectors, 2013 - 2018*

	$\beta$	Standard error	t	p
<b>Meat</b>				
Constant	0,08	0,03	2,71	0,007
In sales variation <sup>a</sup>	0,89	0,03	34,57	0,000
Decrease in sales <sup>b</sup>	-0,20	0,05	- 4,05	0,000
R <sup>2</sup>	0,81			
<b>Beverages</b>				
Constant	0,25	0,04	5,57	0,000
In sales variation <sup>a</sup>	0,86	0,04	23,53	0,000
Decrease in sales <sup>b</sup>	-0,44	0,07	- 6,19	0,000
R <sup>2</sup>	0,64			

a. natural logarithm of the year-on-year difference in sales. b. periods of decrease in sales = 1, periods of growth in sales = 0.

*Source:* Authors' own elaboration.

In the beverage production sector, Table 5 shows that when sales increase 1%, costs and expenses increase 0.86%. On the other hand, when sales decrease, costs and expenses show a reduction of 0.42%. In this way, the presence of cost asymmetry in the beverage production sector is ratified, since the difference in data in the face of increases in income and decrease in them is 0.44%, which translates into stickiness in the costs of this sector in Ecuador.

As a robustness analysis of the metrics used, the ABJ model was estimated using panel data with fixed and random effects. In addition, the Chi-squared test proposed by Hausman (1978) was carried out to identify the statistically significant differences between the estimators of the mentioned models.

Table 6 indicates that, according to the Hausman test, the difference in coefficients is not systematic in the meat sector. For this, the random effects model is appropriate. It is observed that, in the face of a positive or negative variation of 1% in sales, costs and expenses vary by 0.84% in both directions. For its part, the Hausman test in the beverage sector indicates that the difference in coefficients is systematic. Therefore, the fixed effects model is appropriate. It is evident that with a growth of 1% in sales, costs and expenses grow 0.438%; while, in a decrease in sales, costs and expenses decrease 0.223%. This situation confirms the existence of cost asymmetry in the sector.

**Table 6**

*Statistical data of the ABJ model through regression with panel data of the meat and beverage sectors, 2013 - 2018*

Effect	Meat			Beverages		
	$\beta$	Standard error	p	B	Standard error	p
Fixed effects						
Intercept	0,058	0,029	0,044	0,110	0,039	0,005
ln sales variation <sup>a</sup>	0,821	0,030	< 0,001	0,438	0,032	< 0,001
Decrease <sup>b</sup>	- 0,057	0,052	0,286	- 0,215	0,666	0,001
R <sup>2</sup> within	0,781			0,464		
R <sup>2</sup> between	0,835			0,877		
R <sup>2</sup> overall	0,805			0,613		
Random effects						
Intercept	0,082	0,048	0,089	0,039	0,049	0,422
ln sales variation <sup>a</sup>	0,840	0,025	< 0,001	0,592	0,027	< 0,001
Decrease <sup>b</sup>	-0,048	0,048	0,317	- 0,134	0,064	0,037
R <sup>2</sup> within	0,781			0,460		
R <sup>2</sup> between	0,835			0,883		
R <sup>2</sup> overall	0,806			0,618		
Hausman						
chi <sup>2</sup>	1.71		0,426	86,120		< 0,001

a. natural logarithm of the year-on-year difference in sales. b. periods of decrease in sales = 1, periods of growth in sales = 0.

**Source:** Authors' own elaboration.

There is evidence of a convergence of the results obtained by the three proposed metrics and the robustness analysis, specifically in the beverage sector. Thus, it is confirmed that the sector shows cost asymmetry with respect to changes in income. Furthermore, the methodologies used are robust to describe and forecast the performance of the sector. However, in the meat sector, the robustness analysis does not confirm the results of the metrics used.

The results presented indicate through the analysis of elasticities that there is a disparity in the variations of costs in the face of a change in sales in periods of growth and reduction of income, a situation that indicates the existence of asymmetric costs in the sectors studied, both for total costs and expenses and personnel expenses. These were similar to the results of Cordova et al. (2018) and Cagigal and Petrovic (2017) in terms of costs and expenses.

Regarding the Anderson et al. (2003) model estimated by linear regression, the results obtained show the existence of cost asymmetry in both sectors under analysis, a situation consistent with that found by Martínez et al., 2020. The estimation of this model by regression with panel data confirms the existence of the phenomenon called sticky cost in the beverage manufacturing sector, in support of the results of Vieira et al. (2014) and Cagigal and Petrovic (2017).

As a result, it was possible to show that the elasticities present cost asymmetry in the two sectors studied, both in total costs and expenses and in personnel expenses, which was corroborated with the linear model. This occurred since the reduction of costs and expenses in periods of decrease

in sales is significantly less than the increase of the same in periods of growth. The ABJ model confirmed the results obtained in the previous models. However, in the estimation of the ABJ model using panel data, the meat sector presents symmetric data in the variation of costs in the face of increases or decreases in income. On the other hand, in the beverage sector, the presence of asymmetry in total costs and expenses was confirmed due to variations in income.

Hence, the presence of sticky cost behavior can be found in the beverage and meat production sectors of Ecuador, proving the theory by using four statistical techniques. The asymmetric cost behavior of the Ecuadorian industry indicates that, even if the country is an emerging economy with restricted monetary policy due to its dollarization, it does not differ from the asymmetric cost behavior observed on the developed economies. However, the causes which develop sticky costs differ from those happening on United States and even on other emerging economies. Then, the results provide empirical evidence of the behavior of companies in the Ecuadorian economy, which experiences an unusual framework, to generate accurate and less risky decision-making.

The exposed findings provide valuable information for companies, which supports timely decision-making for efficient business management; thus, when the asymmetric behavior of costs is verified, investment policies in fixed assets could become stricter, demanding a stable growth of sales as a condition prior to the expansion of capital. Under this premise, and especially in the short term, a prompt strategy to respond to fluctuations in demand will be the management of human talent, adopting flexible contracting modalities or variable salaries, becoming alternatives that reduce the risk of increasing or maintaining costs versus change in revenue.

Additionally, the strategies may also be focused on inventory management and the use of installed capacity. Therefore, the establishment of optimal levels of inventories, which allow covering the demand and possible increases in sales, is essential to combat an eventual increase in the labor force that can trigger costs that in the future cannot be incurred in the event of lower sales. The use of the installed infrastructure for the production of new products will be an opportune strategy in the short term, in search of cost optimization through economies of scope.

It is imperative then, that management evaluate various proposals aimed at maximizing benefits by optimizing resources, hand in hand with continuous monitoring of information that allows anticipating market fluctuations, to counteract emerging decision-making that increases profits. costs, without then being able to manage them.

## 5. CONCLUSIONS

In this work, the asymmetry of the costs of companies belonging to the economic sectors of beverage production and meat processing of Ecuador was determined for the period 2013 - 2018 with the intention of providing reliable information that facilitates managerial decision making. As an answer to the research question, sticky costs are consistently found on the beverage production and meat processing industries from Ecuador; confirming the hypothesis that the companies analyzed show an asymmetric behavior of their total costs and expenses and in their personnel costs and expenses, in the face of a variation in their operating income.

The importance of sectoral studies that describe and analyze the behavior of the business fabric and identify opportunities for improvement with a view to sustainable economic development is highlighted.

The different estimation techniques used confirm similar results for the sectors studied, the existence of an asymmetric behavior of costs. This finding constitutes a significant description of the behavior of manufacturing companies in emerging countries, in terms of the sensitivity of their productive organization and expectations of recovery in the face of declines in their income. Furthermore, the convergence in the results obtained by the measurement tools provides clear indications of robustness and their reliability to determine and predict this phenomenon in emerging economies, which differs from the research carried out previously. The asymmetry evidenced in the analyzed sectors may be explained by several factors, among the most common and corresponding to the study context are: rigidity of the labor market Ribeiro et al. (2005), by making it more expensive for companies to terminate the employment relationship unilaterally; and managerial expectations of a rapid recovery in the level of sales in the face of temporary reductions Chen et al. (2015). For this reason, it is prioritized to maintain the operational recovery capacity of the company, reducing staff turnover or dismissal and future reincorporation of workers.

It is highlighted that personnel expenses present less intensity in the asymmetric behavior when compared to total expenses. This is due to the fact that in periods of economic boom, companies question the hiring of more workers, an aspect that allows them to avoid the intensity of their reduction in times of contraction in sales. This situation is explained by the intention to minimize the costs of staff turnover in a rigid legal environment.

It is important to underline the importance of monitoring this type of behavior using other management tools that allow efficient cost management to be achieved with a view to maximizing profitability. Therefore, aspects such as the determinants of asymmetric costs and managerial expectations of sector performance, make up lines of research that need to be addressed.

Finally, the research adds to the literature by analyzing the cost behavior of two sectors from an emerging economy such as the Ecuadorian one, which has different circumstances to those in both other emerging economies and developed ones. Furthermore, it provides a tool that eases the process of decision-making for the beverage and meat sectors, which can be extended to other similar manufacturing industries. The model makes it possible for management to predict the cost behavior caused by changes on income and to generate strategies to overcome the consequences of those variations and lower their impact on the enterprises' cost structure.

Still, the limitation faced by the paper is the reduced amount of qualitative information on managements' decisions towards changes on costs; which open possibilities for investigation such as planning administration strategies to restrict the cost structure when income drops, and broadening tactics when income raises. Likewise, it is suggested to study the sticky costs influence on efficient business management, knowledge that is not quite developed currently.

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#### AUTHOR'S CONTRIBUTION

All authors contribute equally to the research.

#### CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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