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Impact of Space on Food Sales: An experiment in a Brazilian supermarket

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***Keywords*— Experiment, Food, Retail, Space-Sale Elasticity**.

***Abstract*—** *This article evaluate the space-sales elasticity of a basket of food products. The research adopted a before-after experiment with a control group. We change product spaces in a supermarket for these five categories and then analyze what happened with sales. Results show that all types of food varied above the control group. However, only the three categories considered essential and present in consumption habits had statistical confirmation based on the Chi-Square Test.*

I. INTRODUCTION

Supermarkets are responsible for the last stage of the arrival of products to consumers and, therefore, are an essential link in the agribusiness chain. In an interview with Dinheiro Rural (2019), Marcio Milan, superintendent of the Brazilian Supermarket Association, highlights that the sector plays the function of the cash register of agribusiness.

According to data from the Brazilian Association of Supermarkets, in 2018, the sector had revenues of R$ 355.7 billion, representing 5.2% of the country's GDP. In addition, the industry generated 1,853,122 direct jobs, distributed in 89,673 stores that occupy approximately 22.2 million m² (ABRAS, 2018).

The supermarket industry has significant ramifications, and capillarity these two reasons play a vital role in reaching many consumers. Thus, from the marketing and consumer behavior perspective, this link has great potential to generate value for the agribusiness chain.

According to Hanna, Wozniak, and Hanna (2009), consumer behavior is complex and associated with human behavior. It is associated with the ways people choose, buy, use, and dispose of goods and services to satisfy their desires. Attitudes can shape consumer behavior, formed by the thought processes, emotions, and intended behaviors added to the individual and environmental factors inserted into the person (Hanna, Wozniak. and Hanna 2009).

Additionally, information processing or emotions from appeals, images, and environmental stimuli can encourage purchases (Sethna and Blythe, 2019).

This article evaluated the influence of the exhibition area on supermarket shelves and the sales volume of products in small and medium supermarkets in Brazil.

When discussing the relationship between exhibition space and sales volume, Borin and Farris (1995) identified a correlation between the variables with the variation of parameters. Concerning statistical significance, Cox (1964) detected that some products present statistical differences in the volume sold due to the change in the exhibition area, but this does not occur with certain products.

Analyzing the behavior of companies nowadays, where competition between companies is increasing, Barrey (2007) argues that competition between suppliers, with different strategies to deal with retailers, to obtain greater product exposure, highlights the potential impact that the area has exhibits on sales volume. Eisend (2014) confirmed the elasticity of sales volume concerning shelf space, identifying variation with the product type and size of establishment.

Given the research already carried out, we can posit that it is not conclusive yet. Several factors can influence the elasticity of sales volume due to the exhibition area on shelves. Additionally, the behavior can be different in different situations, as is the case of products from agribusiness. Thus, the research problem was elaborated: What is the impact of the display area on the shelves' sales volume of a food product basket?

To answer this question, the objective of this study was to evaluate the impact of the variable display area on the shelf on the variable sales volume based on a basket of products from agribusiness in a medium-sized Brazilian supermarket located in São Paulo State.

The research results generated subsidies to assess the commercial relations between retailers and companies upstream in the agribusiness chain to create value for both. An essential contribution of the research is that supermarkets can benefit by improving category management and reducing inventory losses. Agribusiness supplier companies could use this information for their commercial strategies, such as increasing market share.

The investigation acquired particular importance as it was carried out during the COVID 19 pandemic, so, for this reason, consumers tended to make purchases more quickly, avoiding a more detailed search during the purchase process.

II. LITERATURE REVISION

2.1 Agribusiness in Brazilian retail

According to the Center for Advanced Studies in Applied Economics, CEPEA (2020), after two consecutive years of unfavorable results for the sector, the Brazilian agribusiness GDP grew by 3.81% in 2019 (21.4% of the Brazilian GDP). The same institution defines agribusiness as an economic sector with links to the agricultural chain, both upstream and downstream. It involves the production of inputs and raw materials, processing, distribution, and other services up to final consumption or export.

Upstream, the agribusiness chain comprises chemicals inputs, machinery and equipment, fertilizers and fertilizer industries, and the entire sales network for these products. At the center of the chain are rural producers, agro-industrial cooperatives, and processing industries, in which agricultural and livestock products are cultivated, raised, and subsequently processed. Downstream is the distribution network of retailers and wholesalers responsible for making the product reach the consumer. In addition, concerning business dynamics, rural extension agencies, commercial banks, government agencies, and agricultural research agencies are part of the chain (Arieira and Fusco, 2010).

2.2 Consumer behavior: perception and decision making

For Hoyer and Maclnni (2008), perception and decision-making are in two different cores within the scope of consumer behavior. They point out that these two aspects are linked to the psychological nucleus. The one that addresses perception is responsible for the search for knowledge and information to support decision-making, which is in the decision-making process domain, divided into four stages: problem recognition, knowledge search, and decision making a post-purchase evaluation.

According to Sethna and Blythe (2019), consumers build a knowledge base to purchase, obtaining information from the research and previous experiences. The report researched and their intensity vary according to the purchase situation and the product to be purchased.

It is essential to point out that considering the object and circumstance, the intensity of consumer involvement with the decision-making process varies for each type of purchase. According to Zaichowsky (1985), involvement is the perception of the relevance of the purchase object based on the need, value, and interest inherent to people. The more regular the purchase routines and the lower the level of product differentiation, as is the case with part of the products dealt with in this study, the level of involvement tends to be lower. The decision many times is made by inertia, using its heuristics, and without seeking more information (Sethna and Blythe, 2019).

One aspect of great importance during the buying process is perception. According to Hanna, Wozniak, and Hanna (2009), it is the process of selecting, organizing, and interpreting sensations in a context. It starts from exposure to a stimulus, requiring attention to absorb it. Finally, there is the sensation of the response by transmitting this to the brain. For Hoyer and Maclnni (2008), perception occurs when one of our five senses registers impulses.

In addition to the way stimuli are received and processed, other situations influence perception: a) physical environment, which refers to everything present in the shopping environment, being responsible for

influencing consumers through their senses; b) social environment, which includes other people present in the purchasing environment; c) task definition, which refers to the definition of pre-established rules for the purchase process; d) time, which is responsible for all the time reference that influences the purchase process, whether it is the year or an individual state of the moment; and e) previous states, which refer to the state of the consumer moments before making the purchase (Hanna; Worzniak and Hanna, 2009).

It is noteworthy that changes in time and physical environment are strictly related to the influence of the display area on the supermarket shelf on the number of products sold.

2.3 The product display area in supermarkets

Merchandising is the technique for displaying and enhancing the sales process of products at modern points of sale. Additionally, the visual scope contributes to drawing people's attention and showing the products impressive (Quiroz, 2016). For Duran and Vargas (2014), it is a decisive strategy at the time of purchase, given the increase in competitiveness between brands and between stores.

Discussing the evaluation methods for defining the exhibition space, Parente (2000) indicates category management, the sales productivity index, the gross profit indicators by area, and the gross margin return on capital invested in inventory.

It is noteworthy that there are many variables to be addressed to modify the display of products and impact sales volume, such as shelf height, shelf ends, and layout, considering the colors of different products.

The literature review will address the product display area and its impact on sales volume the space-sales elasticity. Curhan (1972) defines sales space elasticity as the relationship between variation in sales and variation in shelf space and affirms that this relationship is not monotonically as there is an increase in area.

Regarding the variation of space-sales elasticity by type of product, Brown, and Tucker (1961) apud Eisend (2014) stratify into three categories: a) inelastic products, which do not respond to changes; b) general-purpose products, which have high elasticity concerning shelf space, and correspond to staple foods; and c) occasional purchase products, which the significant exposure area directly impacts the sales curve, and correspond to impulse purchases. Also, according to Eisend (2014), space-selling elasticity increases as one moves from essential products or commodities to impulse purchase items.

When reviewing the existing knowledge base, Eisend (2014) classified the variables mentioned in the different studies and which demonstrated an impact on sales space elasticity in some factors: a) product and shelf characteristics, which presents the type of product, the level of the added value of the product and the variation of the exhibition area; b) store characteristics, addressing the number and size of stores; c) study characteristics, including the year, location (country, state, city, and neighborhood) and article status; d) research methodology and data characteristics, which considers interaction, estimation method, study design, data types, space measurements, and omitted variables.

III. RESEARCH METHOD

We carried out an analysis using an experiment. The objective was to evaluate the relationships between the independent variable (exhibition area) and the extraneous variables (price, advertising, among others). We can nominate this kind of technique as a strategy field experiment using the method proposed by Chatterji et al. (2016).

Concerning the experiment, Kerlinger (1973) highlights that it is a type of research in which the researcher manipulates and controls the independent variables and observes the impact on the dependent variables simultaneously with the manipulation of the independent variables.

In this work, we use one before-after design with a control group. One treatment occurs with the experimental group, but the control group doesn't suffer any change (Mattar, 2014).

We selected one medium-sized supermarket in São Paulo State, Brazil, for this experiment. Midsize supermarkets play a crucial role in product sales and need to carefully manage their available sales area.

Additionally, we considered: a) the non-linearity of the space-sales elasticity for all product categories, as shown by Brown and Tucker (1961) apud McGoldrick (2002); and b) commodities have a lower elasticity of shelf space than other products, while items amenable to impulse purchases have a higher elasticity (Eisend, 2014). Thus, to verify the elasticity in different product types, we chose products part of the agribusiness chain but with varying degrees of industrial processing and added value.

Five categories of products in the agribusiness chain were selected and exposed to the treatment: a) Rice 5 kg; b) Extra Virgin Olive Oil; c) Soybean Oil (PET); d) Whole palm heart 300 g; and e) Cream cheese (glass).

Additionally, we designed Spaghetti Pasta (6th category) as the control group.

In addition to the independent and dependent variables, which were studied, there was also care with extraneous variables, which could affect the results of the dependent variable (Kinnear & Taylor, 1997). We also controlled price, promotions, distribution, and direct sales during the experiment to avoid external influences (Eisend, 2014). The data collection occurred in the second semester of 2020.

It is noteworthy that data analysis was carried out separately for each category analyzed, evaluating the variation in sales volume from the variation in the display area on the shelf of each brand in the selected types. We perform one Chi-Square test for each category. The analysis was supported by the Minitab statistical software, version 18.

IV. PRESENTATION AND RESULTS DISCUSSION

We conducted the research in a supermarket with a sales area of almost 540 m² and four checkouts. There was an average flow of 653 assistances per day during the survey period, with an average ticket of US$ 8. We obtained this information from the supermarket's management system, interviews with the owner and employees, and direct observation at the research site.

We observed a greater volume of sales on weekends and the first ten days of the month, so, considering that the period evaluated was two weeks, the comparison was not given in absolute sales numbers but based on the proportionality of the brands within each category.

The experiment data are in Table 1, where we highlight some points: the sales volume of each brand (in units) and its proportion within the category in both periods; shelf display area; and the variation in the proportion sold of each brand within the category, considered in percentage points.

The Chi-Square test considers the null hypothesis that the variables are independent; in this, the area of exposure on the shelf does not affect the brand's sales volume. The alternative idea is that the variables are dependent, that is, that the area of Shelf exposure affects sales volume. As a decision criterion, the p-value is used, and if it is less than the desired level of significance, the null hypothesis is rejected.

Table 1: Experiment Results

Products	Period 1			Period 2			Sales Variation (p.p.)
	Sales		Area of shelf exposure	Sales		Area of shelf exposure	
	Units	Proportion		Units	Proportion		
Rice 5 Kg							
Rice 1	30	24%	4	14	13%	2	-11%
Rice 2	29	23%	4	17	16%	3	-7%
Rice 3	47	38%	2	49	46%	2	9%
Rice 4	19	15%	3	26	25%	4	9%
Extra Virgin Olive Oil							
E.V. Olive Oil 1	9	21%	4	7	16%	2	-6%
E.V. Olive Oil 2	6	14%	2	10	23%	4	8%
E.V. Olive Oil 3	21	50%	5	17	39%	5	-11%
E.V. Olive Oil 4	6	14%	2	10	23%	3	8%
Soybean Oil							
Soybean Oil 1	139	37%	5	40	12%	1	-25%
Soybean Oil 2	96	26%	8	174	54%	12	29%
Soybean Oil 3	139	37%	11	107	33%	11	-4%
Whole Palm Heart 300 g							
Palm Heart 1	9	64%	8	5	42%	5	-23%
Palm Heart 2	3	21%	1	6	50%	4	29%
Palm Heart 3	2	14%	1	1	8%	1	-6%
Cream Cheese (glass)							
Cream Cheese 1	18	29%	6	24	38%	11	8%
Cream Cheese 2	14	23%	5	23	36%	5	13%
Cream Cheese 3	30	48%	6	17	27%	3	-22%
Spaghetti Pasta							
Spaghetti Pasta 1	33	50%		18	55%		5%
Spaghetti Pasta 2	9	14%		4	12%		-2%
Spaghetti Pasta 3	24	36%		11	33%		-3%

Source: Experiment carried out between 05/04/2020 to 05/10/2020 – "Period 1" and 05/12/2020 to 05/18/2020 – "Period 2"

Table 2 presents the Chi-Square Test result for each category exposed to the experiment and the control group, considering the significance levels of 0.1, 0.05, and 0.01.

From the results of the Chi-Square Tests, we noted that the control group did not have the null hypothesis rejected. There was no change in the proportion sold of each brand of Spaghetti Noodles between the two periods of the experiment. This fact is desirable and validates the investigation, mitigating the interference of external factors in the results.

The Chi-Square Test for the Extra Virgin Olive Oil and Whole Palm Heart categories did not have the null

hypothesis rejected. The p-value was more significant than the three significance levels considered. Thus, despite the variation in the sales proportions shown in Table 1, it is not possible to statistically state a dependence between the variables in these categories.

We can notice that the variation in the exposure area on the shelf influenced the proportion sold of the brands of Rice, Soybean Oil, and Cream Cheese. Therefore, they had the null hypothesis rejected (they had a p-value minor than the significance level of 0.05), this meaning that the variables are dependent.

Furthermore, it is noteworthy that the null hypothesis was also rejected for the Soybean Oil category when the test for a significance level of 0.01 was performed. Therefore, it reinforces the dependence on the variables, shelf space, and sales volume in this category of products.

For the categories that had statistical confirmation of the dependence between the variables, shelf display area, and brand sales volume, Figure 1 shows the relationship between the percentage change in shelf display area between the two periods and the variation of sales of each brand within the category measured by percentage points, between period one and period two.

From the comparison, it was possible to see that the behavior is different between the categories; it is highlighted that there was strong linearity in the Rice and Soybean Oil category. Unlike the cottage cheese category, the Cream cheese had an 83% increase in the exhibition area and only eight percentage points (pp) in sales volume. In contrast, the Cream cheese two brands had no change in the sales area but had a 13 (pp) increase in sales.

Table 1: Chi-Square Test Results

Category	Chi-Square	DF	p-value	Significance level 0.1	0.05	0.01
Rice 5 Kg	8.574	3	0.036	*	*	
Extra Virgin Olive Oil	2.626	3	0.453			
Soybean Oil	77.861	2	0.000	*	*	*
Whole Palm Heart 300 g	2.336	2	0.311			
Cream Cheese (glass)	6.612	2	0.037	*	*	
Spaghetti Pasta	0.184	2	0.912			

Source: Minitab analyzes

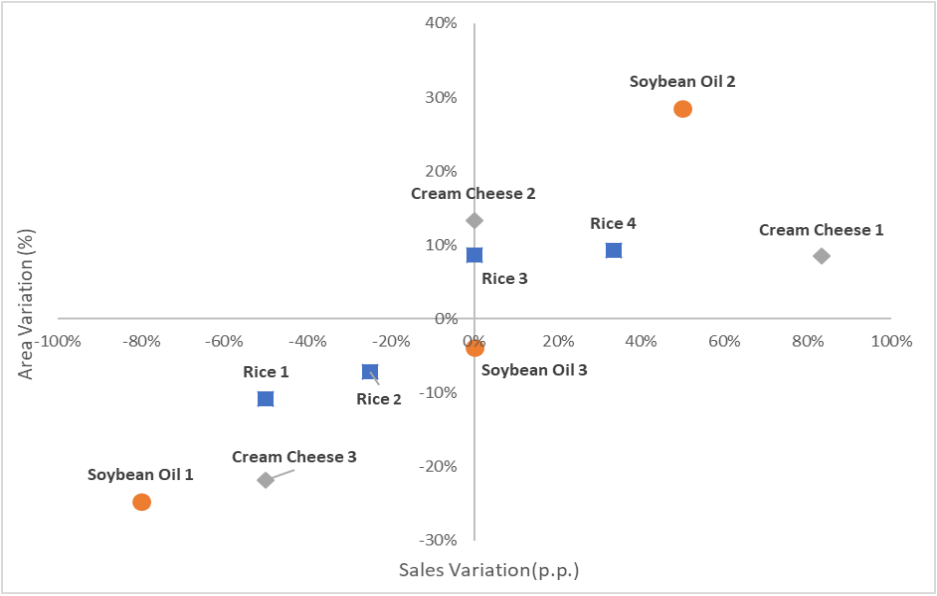

Fig.1: Comparative - Area Variation (%) vs Sales Variation (p.p.)
Source: Authors

The regression equation is:
Sales variation (p.p.) = 0.01065 + 0.2777 Area variation (%)

Model Summary

S	R2	R2(ad)
0.0977902	69.34%	65.50%

Analysis of Variance

Source	GL	SQ	QM	F	P
Regression	1	0.172997	0.172997	18.09	0.003
Error	8	0.076503	0.009563		
Overall	9	0.249501			

Fig.2: Simple Regression Analysis - Categories with Dependency

Source: Minitab analyzes

With different behaviors between categories and the non-linearity of the variation in the sale of brands, a possible explanation can be expected, which may be the impact of other variables that influence the purchasing behavior of consumers, such as packaging characteristics, price, and preference among brands.

From the set of brands of the categories that had the null hypothesis rejected, a simple regression test was performed, with the support of the Minitab 18 software, to verify the existence of a model that statistically represents the behavior of this data set. Thus, Figure 2 presents the model's equation and the verification criteria for accepting or not its representativeness.

The model representing the data set present in the comparison in Figure 1 demonstrates that the Sales variation (p.p.) is equal to 0.01065 added to 0.2777 times the Area variation (%). The adjusted R^2 indicates that the variation in the sales area explains 65% of the variation in the proportion of sales. Finally, the p-value of 0.003 suggests that the correlation between the variables is statistically significant.

V. CONCLUSION

The objective of the experiment was to evaluate the impact of the food exposition on the variable sales volume in a supermarket. An investigation was carried out divided into two periods, with weekly amplitude. We exposed and measured five categories of products, where the brands had their exhibition area modified in the second period, and the proportion of sales between the brands was compared.

From the evaluation of the variation in the proportion of each brand's sales, it was noticed that all categories varied significantly above the control group.

When the Chi-Square tests were conducted, they confirmed the statistical significance; it was found that in the Rice, Soybean Oil, and Cream Cheese categories, the impact of the variation in the area of the display on the shelf was confirmed on the proportion of the sale of each brand. However, there was no such confirmation in the categories Extra Virgin Olive Oil and Whole Heart. Therefore, it was impossible to state that the variables are dependent on these two last categories.

As part of the experiment, the planning of product categories contemplated different levels of products regarding the added value and degree of industrial processing in each one of them. Thus, the assessment under this perspective is to identify the differences between those who had statistical confirmation of dependence and those who did not have such proof.

It is noticed that the categories of products that did not have statistical confirmation show some differences from the confirmed types, such as they are considered food not essential (as they are not part of the population's essential diet).

Finally, these products have a greater added value, so their prices are higher, and the attributes and perceived quality influence the purchase decision (loyalty).

It is noteworthy that the display area on the shelf influences the sales volume of brands so that each product category is impacted in a particular way.

Therefore, it should be noted that the management and control of the product display area on the shelf can benefit supermarkets, such as increased inventory turnover, selling products with higher profit margins, and selling products with a higher risk of loss due to maturity.

As far as agribusiness companies are concerned, knowledge of the impact of the display area on the shelf on the sales volume of their product category can be an essential factor in sales negotiation and a strong lever for increasing market share.

We can consider two points as limitations of the study: the fact that the experiment was carried out in the middle of a pandemic and the weekly time horizon for the periods of the investigation.

Concerning experimenting during a pandemic period, it is noteworthy that it brought particular importance to the research, given that, in the face of the pandemic. The need for social distance and measures to combat it resulted in the determination of the population to spend the least

amount of time out of their homes, directly impacting the decision-making time of consumers in supermarkets.

As a suggestion for future studies, we highlight the expansion of the experiment. Some possible increments could be: a) consider more research objects, that is, two or more supermarkets with different sizes; b) increase the number of periods of the experiment, considering more than two periods, all of them being controlled and planned by an experiment design; and c) increase the number of categories, considering different levels of the added value of the products. The expansion of the experiment will allow the identification of models in the product categories so that it is possible to predict the number of sales.

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