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Tesis

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Analysis of the Financial Efficiency of Companies in the Industrial Sector during COVID-19: Case Study in Peru

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***Abstract*—The pandemic has created an environment of considerable uncertainty, forcing companies to efficiently manage their resources to optimize their profits, prevent falling revenues, sustain the chain of payments and preserve employment. The objective of this research is to apply the Data Envelopment Analysis (DEA) method to know the financial impact of the COVID-19 crisis on Peruvian companies in the industrial sector, which are listed on the Bolsa de Valores de Lima. Multi-criteria model and correlation analysis were used for the validation of financial ratios, DEA method was used to evaluate efficiencies and Malmquist Productivity Index (MPI) to analyze changes in performance by quarter. Results indicate that 77% of companies are inefficient, equity items and administrative expenses are the most crucial for these companies to improve their performance; in addition, there is a deterioration of -31.5% in the total productivity of the sector mainly caused by the decrease in technological progress. This research offers decision-makers a tool that allows them to devise strategies to face the continuing financial crisis and promote investment in the use of technologies that may contribute to the improvement of productivity.**

Keywords—data envelopment analysis, financial efficiency, COVID-19, industrial sector

I. Introduction

On March 15, a state of emergency and mandatory social distancing were decreed to safeguard people's health in the face of the COVID-19 outbreak [1], since then Peru has gone through a political and economic crisis that it caused a 15.5% drop in GDP at the end of 2020 [2].

The situation in Peru during the first quarter of 2020 was very serious compared to other Latin American countries, according to CEPAL (Comisión Económica para América Latina y el Caribe), industrial production fell by 21.4% and the manufacture of capital goods decreased by 47.9% [1].

The pandemic has created an environment of significant uncertainty, forcing companies to change safety conditions for their workers, accelerate digital transformation, and drive processes that seek increases in productivity. Although 57.7% [3] of companies accessed programs and reactivation measures implemented by the Peruvian government, these have not been enough to mitigate losses in organizations [4].

Companies require an efficient allocation of their resources to optimize their profits, avoid falling income, sustain the payment chain and preserve employment [5]. Therefore, financial analysis is essential when evaluating the real economic performance of a company, since it determines whether its financial management is efficient [6] or if it's necessary to alter the inputs to achieve optimal performance.

The meaning of efficiency is expressed in a relationship between the results obtained (outputs) and the inputs used (inputs) [7], thus, when determining the financial efficiency of a company we know how capable they are of generating economic value with the resources that they possess and how they react to frequent political, economic and social gaps.

In this context, what was the situation of companies during the economic crisis due to the state of emergency after COVID-19? Which firms were efficient and which were not? How can companies improve efficiency in managing their resources? Answering these questions requires the application of a tool that determines the efficiency of financial ratios, so this research aims to apply the Data Envelopment Analysis (DEA) method to know the financial impact of the COVID-19 crisis on Peruvian companies in the industrial sector, which are listed on the Bolsa de Valores de Lima (BVL).

II. Literature Review

A. Data Envelopment Analysis

Data Envelopment Analysis or DEA is a nonparametric method used to measure the relative efficiency of decision making units (DMU), which can be evaluated regarding their abilities to become input or output [8]. Thus, to perform an adequate DEA analysis, data on the resources (inputs) and the product (output) of each of the entities are required. The general DEA equation in (1) is subject to the restriction in (2).

$$Max \;\; \theta = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \tag{1}$$

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1; j = 1 \dots n \tag{2}$$

$$u_r v_j \geq 0; \quad r = 1 \dots s; \quad i = 1 \dots m.$$

where y_{r0} represents the amount of output produced, x_{i0} is the input consumed, y_{rj} is the output produced by j, x_{ij} is the input i consumed by the j, u_r is the weight assigned to input r, and v_i is the weight assigned to input i.

a) Returns to scale: There are 2 basic models in DEA, the first is the Constant Returns to Scale (CRS) reflects the fact that production will change in the same proportion as the

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inputs are modified. According to [9], it could be used to obtain a wide variety of duality relationships to interpret the results according to the weights generated by the algorithm.

The second proposes Variable Returns to Scale (VRS) with the axiom of convexity instead of the proportionality between inputs and outputs.

Banker proposes an additional restriction to CCR model, which divides the efficiency into Pure Technique Tfficiency (PTE) and Scale efficiency (SE). The product of these allows us to obtain the Global Technical Efficiency (GTE) [9].

If SE is equal to 1, it doesn't present efficiency at scale, so it operates at optimal scale. However, if SE turns out to be less than 1, the frontier of variable returns should be collated with that of nonincreasing returns, in order to establish the return in which the DMU operates, increasing or decreasing [10].

b) Typology of returns: The types of returns that production technology represents are constant returns to scale (crs) given when the percentage of increase of the output is equal to the percentage of increase of the input, increasing returns (irs) given when the percentage of increase of the output is greater than that of the input and decreasing returns given when the percentage of increase of the output is less than that of the input [11].

c) Orientation of model: This is divided into input oriented, where it seeks to reduce the inputs proportionally to the maximum in order to remain within the frontier. And output oriented, where the level of inputs has been found, it seeks to increase the outputs proportionally to the maximum while maintaining the unit at the frontier [12].

B. Malmquist Productivity Index

Malmquist Productivity Index (MPI) initially developed by Caves, Christensen and Diewert [13], is a technique based on the assumption that the distance function of inputs or outputs is similar to the inverse of the Farrell measure [14].

MPI is divided into its components: [15] of total factor productivity change (TFPCH) that calculates efficiency improvements in production processes [16], efficiency change (EFFCH) that measures the ability to use inputs in optimal proportions and technical change (TECHCH) that reflects the ability to obtain the maximum product given technological factors. This relationship is shown in (4) using the ratio of distance functions, where M is the change in TFPCH between two consecutive periods, if M=1 productivity doesn't change, and decreases if it's less than 1 [13].

$$M_{(t,t+1)} = \left[\frac{D^t(X^{t+1},Y^{t+1})}{D^t(X^t,Y^t)} \cdot \frac{D^{t+1}(X^{t+1},Y^{t+1})}{D^{t+1}(X^t,Y^t)}\right]^{\frac{1}{2}} \quad (3)$$

In equation (3), $D^t(X^{t+1},Y^{t+1})$ is the ratio of the distance functions of two consecutive periods (t,t+1) that show the efficiency change (EFFCH), [·]^(1/2) is the geometric mean of the change in output between X^t and X^{t+1} which refers to the technical change (TECHCH). Therefore, efficiency can also be defined as TFPCH(t,t+1)= EFFCH(t,t+1) x TECHCH(t,t+1).

DEA and MPI have been applied jointly in various fields, for example, in the study of Fontalvo [17] and Wang [18] where the financial items of exporting and fishing companies were inspected respectively. Thus, the relevance of the use of its variables was demonstrated and the precision of these methodologies to evaluate the efficiency was confirmed.

III. METHODOLOGY

The methodology followed is illustrated in in Fig. 1.

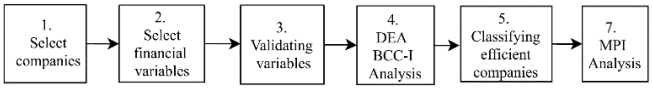


Fig. 1. Financial efficiency analysis methodology

It's important to mention that data and variables collected are limited to the public information available on Bolsa de Valores de Lima website. The sample was determined under the criteria proposed by [19]. Companies in the industrial sector selected for their homogeneity in the structure of their financial results [20] were 30, which were named for the convenience of the study as DMU1, DMU2 ..., DMU30.

Nonparametric models such as DEA require an adequate identification of the inputs and outputs [21], therefore, level of discrimination and its level of correlation were considered for their selection. For the first, the multicriteria model proposed by [22] in which variables with high discriminatory power are considered the best candidates, so, CCR model is used because this is more discriminatory than BCC [9]. Also, correlation analysis was performed to verify low correlations among variables (inputs among inputs and outputs among outputs); similarly, there must be high and positive correlations between inputs and outputs [23].

To know the model to use, [24] recommends performing the Kolmogorov-Smirnov test, where if the null hypothesis is accepted or if the test statistic is close to 1, the CCR model is chosen, but if it is rejected, the BCC model must be chosen. Finally, discriminant analysis was performed to validate the efficiency classification and verify the existence of significant differences between the groups [25]. Financial indicators were used as independent variables and dependent variables were the classification results obtained from the DEA.

IV. RESULTS

A. Selection of Financial Variables

Preliminary variables were selected based on previous studies [18, 26, 27]; being the inputs: total assets (TA), total liabilities (TL), equity (EQ), cost of sales (CS), selling expenses (SE) and administrative expenses (AE) and as output, total sales (TS). The number of variables satisfies the general rule proposed by [28], where the product of inputs (6) and outputs (1) is less than one third of the DMU amount.

TABLE I. MULTICRITERIA MODEL FOR THE SELECTION OF VARIABLES

Criteria	Iteration	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Medium efficiency	*TS - CS*	0.353	0.388	0.533	0.437
	TA (I)	0.631	0.637	0.778	0.690
	TL (I)	0.699	0.667	0.825	0.738
	EQ (I)	0.736	0.698	0.829	0.747
	AE (I)	0.758	0.762	0.846	0.782
	SE (I)	0.933	0.884	0.932	0.922
Number of efficient DMU	*TS - CS*	1	1	1	1
	TA (I)	3	3	3	3
	TL (I)	4	5	6	5
	EQ (I)	6	6	6	6
	AE (I)	6	8	8	6
	SE (I)	13	13	13	11

B. Variable Validation

First, the multicriteria model was performed in Table I, where a considerable difference was found in the number of DMUs that become efficient by adding a variable during the first four iterations. However, in the fifth iteration, which considers the selling expenses (SE) variable, the number of efficient units increases significantly by adding seven efficient DMUs in the first quarter (Q1), so it is considered to eliminate this variable.

Next, a Correlation Analysis was performed to verify this decision. The results shown in Table II calculated with the Pearson Correlation (r), indicate a high positive and significant correlation (Sig.) between the inputs and outputs, with the exception of selling expenses variable. This means that the data set that considers these variables satisfies the isotropic conditions and can be used for calculations with the DEA methodology. [29].

T Therefore, the variables considered in the final model would be TA, TL, EQ, CS, AE and TS.

TABLE II. RESULTS OF CORRELATION ANALYSIS

Variable		TS	TA	TL	EQ	CS	SE	AE
TS	*r*	1						
	Sig.							
TA	*r*	0.885[a]	1					
	Sig.	0.000						
TL	*r*	0.887[a]	0.989[a]	1				
	Sig.	0.000	0.000					
EQ	*r*	0.800[a]	0.935[a]	0.872[a]	1			
	Sig.	0.000	0.000	0.000				
CS	*r*	0.969[a]	0.850[a]	0.865[a]	0.737[a]	1		
	Sig.	0.000	0.000	0.000	0.000			
SE	*r*	0.363[a]	0.265[a]	0.235[a]	0.312[a]	0.166	1	
	Sig.	0.000	0.003	0.010	0.001	0.070		
AE	*r*	0.758[a]	0.739[a]	0.710[a]	0.740[a]	0.641[a]	0.563[a]	1
	Sig.	0.000	0.000	0.000	0.000	0.000	0.000	

[a] Correlation is significant at the 0.01 level (2-tailed).

C. DEA Analysis

Efficiency was determined using input-oriented model, on the basis that, in a situation of financial crisis, it would be convenient to take as a reference those companies that managed their resources efficiently in order to mitigate the impact of the paralysis of productive work rather than standing out in its sector [30].

When running the Kolmogorov-Smirnov test, the test statistic was 0.176 with an alpha value of 0.000; thus, the use of the BCC model was chosen. This result was justified by coinciding with [31], by leaning towards BCC models if DMU of variable size are considered, in this model the units will take as a reference the units of the same size and the effect of economies of scale is not considered [32].

Companies that remained efficient (E_0=1) throughout the year were seven (DMU5, 6, 18, 20, 25, 27 and 29), representing 23.3% of the total sample. In the first quarter ten DMU achieved efficiency, thirteen DMU in the second quarter, fourteen DMU in the third quarter, however, in the fourth quarter there were only eleven efficient DMU.

Regarding returns to scale, in the third quarter 43.3% of DMU have decreasing returns (drs), that is, the percentage growth of their outputs (TS) is lower than the percentage growth of their inputs (TA, TL, EQ, CS and AE). Throughout the year there are five DMU (DMU1, 13, 17, 21 and 30) with increasing returns (irs), this means that they operate at an optimal scale since the percentage increase in profits is greater than that of resources, but they could increase production by scaling up to constant returns (crs).

TABLE III. DATA ENVELOPMENT ANALYSIS RESULTS

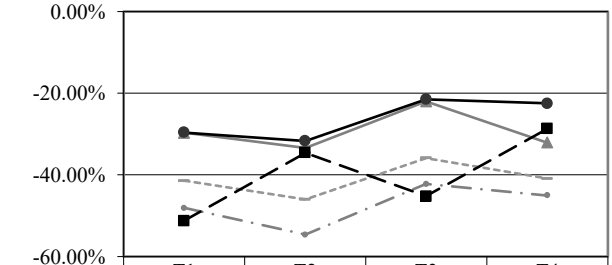
DMU	Company name	Location	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
			E_0	δ	E_0	δ	E_0	δ	E_0	δ
DMU1	AGROINDUSTRIAS AIB S.A.	Lima	0.728	irs	0.756	irs	0.647	irs	0.679	irs
DMU2	ALICORP S.A.A.	Lima	0.769	drs	1	drs	1	drs	0.976	drs
DMU3	AUSTRAL GROUP S.A.A.	Lima	0.476	irs	0.650	irs	0.932	drs	0.641	irs
DMU4	CEMENTOS PACASMAYO S.A.A.	Lima	0.435	irs	0.411	irs	0.700	crs	0.596	crs
DMU5	CERVECERÍA SAN JUAN S.A.	Ucayali	1	crs	1	crs	1	crs	1	crs
DMU6	CONSORCIO INDUSTRIAL DE AREQUIPA S.A.	Arequipa	1	crs	1	crs	1	crs	1	irs
DMU7	CORPORACIÓN ACEROS AREQUIPA S.A.	Ica	0.794	crs	0.731	drs	0.920	drs	0.999	drs
DMU8	CORPORACIÓN LINDLEY S.A.	Lima	0.861	drs	0.845	drs	0.753	drs	1	drs
DMU9	CREDITEX S.A.A.	Lima	0.782	drs	0.565	irs	0.799	drs	0.838	irs
DMU10	EMPRESA EDITORA EL COMERCIO S.A.	Lima	0.76	drs	0.542	irs	0.822	irs	0.758	irs
DMU11	EMPRESA SIDERÚRGICA DEL PERU S.A.A.	Lima	0.978	irs	0.682	irs	1	crs	1	crs
DMU12	EXSA S.A.	Lima	0.764	irs	0.680	irs	0.738	crs	0.746	irs
DMU13	FÁBRICA NACIONAL DE ACUMULADORES ETNA S.A.	Lima	1	irs	1	irs	1	irs	0.973	irs
DMU14	FÁBRICA PERUANA ETERNIT S.A.	Lima	0.835	drs	1	crs	1	crs	1	crs
DMU15	HIDROSTAL S.A.	Lima	0.619	irs	1	irs	0.909	drs	0.763	irs
DMU16	INDECO S.A.	Lima	1	crs	0.757	crs	1	drs	1	crs
DMU17	INDUSTRIAS DEL ENVASE S.A.	Lima	0.886	irs	0.851	irs	0.883	irs	0.873	irs
DMU18	INDUSTRIAS ELECTRO QUIMICAS S.A. - IEQSA	Lima	1	crs	1	crs	1	crs	1	crs
DMU19	LAIVE S.A.	Lima	0.997	irs	1	crs	1	crs	0.929	irs
DMU20	LECHE GLORIA S.A.	Lima	1	drs	1	crs	1	drs	1	drs
DMU21	MANUFACTURA DE METALES Y ALUMINIO "RECORD"	Lima	1	irs	1	irs	0.975	irs	0.880	irs
DMU22	MICHELL Y CIA. S.A.	Arequipa	0.903	irs	0.807	irs	0.890	drs	0.809	irs
DMU23	MOTORES DIESEL ANDINOS S.A.	Lima	0.58	drs	0.699	irs	0.690	irs	0.681	irs
DMU24	PESQUERA EXALMAR S.A.A.	Lima	0.402	irs	0.891	drs	1	drs	0.555	irs
DMU25	PETRÓLEOS DEL PERÚ - PETROPERÚ S.A.	Lima	1	drs	1	drs	1	drs	1	drs
DMU26	QUIMPAC S.A.	Lima	0.601	irs	0.768	irs	0.536	drs	0.445	irs
DMU27	REFINERÍA LA PAMPILLA S.A.A. - RELAPA S.A.A.	Lima	1	crs	1	crs	1	crs	1	drs
DMU28	UNIÓN ANDINA DE CEMENTOS S.A.A. -UNACEM S.A.A.	Lima	0.425	irs	0.588	drs	0.557	drs	0.811	drs
DMU29	CERVECERÍAS PERUANAS BACKUS S.A.	Lima	1	crs	1	crs	1	crs	1	crs

DMU30	YURA S.A.	Arequipa	0.481	irs	0.516	irs	0.772	irs	0.765	irs

D. Analysis of Average Change in Slacks

To improve their efficiency, inefficient companies must reduce the value of their inputs in the proportions shown in Fig. 2, where it is observed that the most relevant input for this sector is equity (EQ). Likewise, it is observed that the pattern of behavior of the administrative expenses (AE) indicator differs from the others according to the passage of time. In first quarter, an average decrease of -51.2% is required (item that requires the most decrease in this quarter), however, in the second quarter this proportion decreases to -34.6%. This change in favor of the company could be explained by workers salary reduction and labor losses because of the paralysis of production chains [33]. However, in the third quarter this proportion increased again to -45.5%, possibly due to the expenses assumed for compliance with safety protocols and vaccinations for workers, due to the third phase of the economic reactivation that enabled activities for most productive sectors [34] during third quarter.

Regarding the proportion of its inputs that need to be reduced, we can highlight the DMU10, 28 and 26 as those that require greater efforts to reach the efficiency frontier. DMU10 (Empresa Editora El Comercio S.A.) stands out by obtaining a higher percentage in all inputs as observed in Table IV.



	T1	T2	T3	T4
TA	-41.40%	-46.00%	-35.90%	-40.90%
TL	-29.70%	-33.40%	-22.00%	-32.10%
EQ	-48.10%	-54.60%	-42.20%	-45.00%
CS	-29.60%	-31.70%	-21.50%	-22.50%
AE	-51.20%	-34.60%	-45.20%	-28.70%

Fig. 2. Average change in inputs per quarter

TABLE IV. FIRMS THAT REQUIRE GREATER DECREASE IN THEIR INPUTS

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
TA	DMU10(69.8%)	DMU28(76.9%)	DMU10(77.1%)	DMU10 (74.7%)
TL	DMU24(59.8%)	DMU28(67.5%)	DMU26(46.4%)	DMU24 (71.3%)
EQ	DMU10(81.2%)	DMU28(85.1%)	DMU10(90.4%)	DMU10 (83.7%)
CS	DMU10(69.8%)	DMU4(59.9%)	DMU26(46.4%)	DMU26 (55.5%)
AE	DMU10(81.8%)	DMU12(86%)	DMU10(90.4%)	DMU12 (76.2%)

E. Classification of Companies Using Discriminant Analysis

Classification was made considering efficiency as a classification variable, those DMUs that reached the production frontier during four quarters were considered efficient. A correct classification of 86.7% on average was obtained from the calculation, as shown in Table V.

F. Analysis of the Change in Efficiency Levels during the 4 Quarters of 2020

TFPCH, EFFCH and TECHCH average was calculate for each company in Table VI. According to Malmquist's Index, if the value from one period to another has been greater than 1, means that its productivity is increased [35].

There is no evidence of a progressive improvement in the total factor productivity change in any period (average TFPCH <1), the average quarterly rate of progress was -31.47%, this can be calculated by subtracting 1 from the average value shown in the table. The DMU6 (Consorcio Industrial de Arequipa S.A.) achieves the highest score in TFPCH, which is consistent with its invariable efficiency throughout the year as seen in Table III.

To analyze the deterioration of the TFPCH in a specific way, the results are broken down in terms of technical efficiency (EFFCH) and technological advances (TECHCH). Regarding efficiency change, 67% of companies have shown improvement (individual EFFCH > 1) from one quarter to another, however, this improvement is not significant since it has not contributed to the growth of the total factor productivity change.

The same does not happen with the change in technology, since no DMU has managed to reach a value greater than or equal to 1, so they do not contribute to the productivity of companies. The degree to which EFFCH and TECHCH contribute to the change in productivity of the total deterioration factor is -0.11 and -31.34%, respectively, so it can be said that the low productivity is mainly due to the limited technological progress of the companies presented.

TABLE V. CLASSIFICATION RESULTS USING DISCRIMINANT ANALYSIS

			Predicted group membership		Total
			Efficient	*Inefficient*	
Original	Count	Efficient	4	3	7
		Inefficient	1	22	23
	%	Efficient	57.1	42.9	100
		Inefficient	4.3	95.7	100

[a.] Correlation is significant at the 0.01 level (2-tailed).

TABLE VI. MPI ANALYSIS BY COMPANY

DMU	EFFCH	TECHCH	TFPCH
DMU1	1.001	0.667	0.667
DMU2	1.000	0.631	0.631
DMU3	0.999	0.663	0.662
DMU4	1.008	0.673	0.678
DMU5	0.991	0.658	0.652
DMU6	0.975	0.943	0.920
DMU7	1.000	0.657	0.657
DMU8	0.997	0.683	0.681
DMU9	1.002	0.646	0.647
DMU10	1.006	0.650	0.654
DMU11	1.024	0.676	0.692
DMU12	1.000	0.658	0.658
DMU13	0.958	0.860	0.824
DMU14	1.004	0.652	0.654
DMU15	1.005	0.677	0.681
DMU16	1.002	0.655	0.656
DMU17	0.999	0.789	0.788
DMU18	1.001	0.768	0.769
DMU19	0.997	0.654	0.652
DMU20	0.992	0.672	0.667

DMU21	1.000	0.754	0.754
DMU22	1.000	0.649	0.649
DMU23	1.000	0.654	0.654
DMU24	0.999	0.676	0.676
DMU25	1.000	0.630	0.630
DMU26	1.014	0.677	0.686
DMU27	0.992	0.672	0.666
DMU28	1.000	0.649	0.649
DMU29	1.000	0.641	0.641
DMU30	1.000	0.664	0.664
Average	0.999	0.687	0.685
Max	1.024	0.943	0.920
Min	0.958	0.630	0.630
Rate of progress	-0.11%	-31.34%	-31.47%

V. Conclusion

The measures taken by the government in the face of the COVID-19 pandemic have caused a reduction of 21.4% in Peru's industrial production [1], this effect can be seen reflected in the economic performance of an organization that has been compromised in the face of great uncertainty. Thus, in order to discover the impact of the COVID-19 crisis on financial efficiency, DEA methodology has been applied to 30 companies in the industrial sector listed on the Bolsa de Valores de Lima.

The variables applied in the model were total assets (TA), total liabilities (TL), equity (EQ), cost of sales (CS) and administrative expenses (AE) as inputs; and total sales (TS) as output. Results show that only 23% of the companies studied achieved efficiency throughout 2020, only ten DMU were efficient in the first quarter, thirteen DMU in the second, fourteen DMU in the third and only eleven in the fourth quarter. The companies AGROINDUSTRIAS AIB S.A., FÁBRICA NACIONAL DE ACUMULADORES ETNA S.A., INDUSTRIAS DEL ENVASE S.A., MANUFACTURA DE METALES Y ALUMINIO RECORD and YURA S.A., could achieve efficiency by increasing their production scale until reaching a constant performance. It was evidenced that the constant fluctuation of equity and high variation of administrative expenses due to the new requirements of security protocols and workers vaccination (costs assumed by companies), affected its performance in the third quarter of the year.

Malmquist's analysis showed that no company reached the TFPCH (average TFPCH <1) since the quarterly average rate of progress was -31.47%, where technological advances (EFFCH) and technical efficiency (TECHCH) contribute -0.11 and -31.34% of low productivity, respectively. Despite the authorization to produce goods classified as essential [29]; majority of companies that have continued to operate have had difficulties in the provision of domestic and imported inputs for production, this is evidenced in the decrease of technical efficiency change (EFFCH).

Results of this study show that companies in this sector should focus on prioritizing the management of their technologies to ensure the continuity of the production chain and its benefits in the face of disruptive situations like this one. Investment in technology that responds to new consumer habits, equipment that allows remote monitoring and new communication technologies that do not require face-to-face, translate into cost savings in favor of the organization and a prosperous economic growth.

As in any study, this research has some limitations. First, the availability of financial information from companies in the industrial sector that are not listed on the Bolsa de Valores de Lima prevents the possibility of generalizing the results and generating a more in-depth analysis; therefore, future studies could include an analysis by subsectors of Peruvian industry with a more significant sample. Second, in this study the number of financial variables used is limited by the number of units evaluated; future research could increase the number of variables and the number of units analyzed in order to generate more precise results about the impact of companies as a result of this crisis.

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