

JEBI

ISSN 2791-8122

VOLUME: 5

ISSUE: 2

2025

Journal of

**ECONOMICS AND BUSINESS
ISSUES**



JEBI

**JOURNAL OF ECONOMICS
AND
BUSINESS ISSUES**

VOLUME: 5

ISSUE: 2

July 2025





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Journal of Economics and Business Issues

July 2025, Volume: 5 Issue: 2

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Trends in Efficiency of Angolan Commercial Banks Outside the Top Ten: A DEA Window Analysis

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Abstract: The objective of this study is to analyze the trend in the relative efficiency levels of Angolan commercial banks, whose asset size means that they are not included in the group of the ten largest. The DEA methodology was adopted, applying input-oriented radial models, namely: CRS and VRS, based on the efficiency averages obtained between windows. The sample included banks that, due to the small size of their assets, their performance has not been subject to systematic analysis. The results obtained indicate that, although the average of the pure technical efficiency scores is higher than the average of the technical efficiency of scale scores, in the period (2016-2023), pure efficiency shows an upward trend, contrary to scale efficiency which shows a downward trajectory, and that the uncertainty associated with the observance of the identified trends is greater for the average scores obtained for scale efficiency than for pure efficiency. Within the scope of commercial policies aimed at increasing banking efficiency, this study can contribute to a more informed view, which allows decision-making, the basis of which goes beyond the traditional standard profit function, where only the profitability of banks is considered.

Keywords: Angolan banks; Efficiency; DEA; Window analysis.

1. Introduction

In their role as financial intermediaries, banks play an important role in any economy by allocating funds between different economic agents. This role, which is also one of the main sources of revenue for banks, represents one of the most consistent ways in which banks acquire and consolidate their assets over time. Thus, their size is important, as it gives them the ability to be more resilient to adverse events inherent in the banking business.

The size of bank assets, such as the volume of resources held by them, from which they generate profits, i.e., seek to be efficient, is an indicator that has been the basis for assigning scores that classify them according to their size. However, the size of their assets does not always accurately reflect the dynamics of the banks' activity, present in the levels of productive efficiency that they experience.

The analysis and importance of banking efficiency, as a way of understanding how banks optimize productive resources, is not a recent concern, a fact attested by several pioneering studies (1).

The efficiency of banks depends on factors that directly or indirectly affect cost absorption and service provision. Over the past 20 years, these factors have been the subject of extensive analytical and empirical literature, driven not only by the major financial crises of recent decades but also by structural changes in the sector (2). Such discoveries have led financial sector firms in general, and banks in particular, to resize the scale of their operations.

In Angola, the cases of the banks BCS (Banco de Crédito do Sul) and Banco YETU, integrated in the SADC banking association, can be cited, which demonstrate that they are making a greater effort to internationalize their activities, increasingly focused on conquering new markets, aiming at possible gains both by optimizing their resources (operational gains) and by increasing the size of their operations (economies of scale), that is, seeking to be more efficient. The bibliometric analysis of the literature on the evaluation of the efficiency of commercial banks in Angola, in the period between 2008 and 2024, from authors such as: (3) (4) (5) (6) (4) (7) and (8), reveal the absence of studies on the evaluation of banks classified as small. This record, normally associated with the systemic importance attributed to banks with larger volumes of assets, and their role in the

Citation: Sanches-António, L. D.

(2025) Trends in Efficiency of Angolan Commercial Banks Outside of Top Ten: A DEA Window Analysis. *Journal of Economics and Business Issues*, 5(2), 01-17.

Received: 08/04/2025

Accepted: 26/06/2025

Published: 31/07/2025

stability of the financial system as a whole (9), may be the basis for the lack of research on the efficiency of banks with relatively smaller assets.

In the literature related to the evaluation of commercial banks, it is common to find studies based on the analysis of economic and financial indexes that provide insights into efficiency levels based on the profitability of equity aggregates and results. However, from a non-metric approach, DEA emerges as a widely used alternative in several analyses on the trend of efficiency scores, such as: the production, asset, value-added approaches and the financial intermediation approach, adopted in this study.

This growing use of the DEA methodology in the process of assessing banking efficiency is mentioned in several articles on bibliometric analysis of DEA production and, in this sense, the work of (10). Traditionally, banks were assessed only considering their financial performance indicators. However, the adoption of this methodology, based on the use of aggregated indicators (ratios), does not always allow for the effective capture of the individualized effect of variables that are difficult to measure at the outset, as is the case with the measurement of the impact of management on the operational performance of banks. Therefore, the DEA approach offers several advantages in contrast.

The possibility that this offers to introduce several inputs and outputs simultaneously, obtaining individual efficiency scores for each of the DMUs under analysis, which may have different units of measurement; it is capable of interacting with both qualitative and quantitative issues; it allows the identification of inefficiencies, constituting an effective decision-making tool by directing management's attention to areas that can be improved; it dispenses with (but can tolerate) pre-specifications of underlying production functions; it can consider systems of preferences of evaluators and managers, assigning weights to the various resources based on the calculation of efficiency, which may reflect certain perceptions of decision-makers regarding the relative importance of certain inputs in the volume of outputs; it is based on individual observations and not on average values, since it uses data already observed (11) and (12).

The objective of this study is to analyze the trend in the efficiency averages of the banks under analysis, based on the efficiency averages obtained between DEA windows, so that the results can allow a more informed understanding of the efficiency patterns of Angolan commercial banking. Given the more informed changes, both in the way management processes and, in the technology, used by banks, over time, it is expected that their performance tends to increase. Thus, the study is justified by the need to seek a more global understanding of the trends in commercial banking efficiency in Angola, providing the information base that can guarantee the taking of managerial and strategic decisions that make Angolan commercial banking more efficient in the long term.

2. Literature Review

2.1. Assessment of the relative efficiency of small banks

It is common in the banking sector for the size of banks to be used to measure the degree of economies or diseconomies of scale, in a given context of efficiency assessment (13).

Since smaller banks generally have a smaller volume of assets, it is expected that the scale of their operations will be more prone to changes, with an impact on the volatility of their efficiency levels. In this sense, the operations of small banks may be more subject to variable returns, so radial models that objectively assess the efficiency of DMUs, whether by minimizing costs or maximizing results, may allow for a better capture of variations in efficiency, based on the analysis of weights based on management, technology or even regulatory aspects, as mentioned in the introduction.

Economists' concern with evaluating the performance of small banks is not new, given their important role in the allocation of credit to small and micro-enterprises, representing an important source of job creation (14).

In Angola, the economic and financial context in which banks operate is particularly difficult, due to considerable levels of informalization of economic activities, financial illiteracy and asymmetric information among economic agents. The process of evaluating smaller banks is more difficult since the aforementioned framework makes them even more heterogeneous. This framework is also corroborated in the financial literature, according to which the performance of small banks, compared to large banks, is affected by differences related to the composition of assets and liabilities, expenses, revenues non-financial, capital ratios, competition and access to credit information, which provide a certain degree of complexity in measuring their efficiency (9).

Considering certain conditions such as their location (rural or urban) or the type of technology used, small banks may be more efficient, regardless of their profitability. This finding is supported by (15), which states that the standard profit function treats large and small banks as if they should have the same variable results, in the presence of the same input and output prices. However, the same authors reinforce the idea that, based on this approach, there is a strong probability of a scale bias occurring, since larger banks have higher profits that are not explained by exogenous variables

(such as context variables). However, several studies evaluate banks, considering their size as an indicator of efficiency, as is the case of (16), (17) and (18).

A given DMU (Decision Making Unit) is considered efficient if it is not possible to reduce any of the inputs without reducing other outputs or to produce more of any of the outputs without increasing other inputs. (19) and (20), therefore, the possibilities offered by models will be presented below, which allow the evaluation of the efficiency, based on observed data, of variables of interest in the banking context, outside the scope of ratios.

2.2. *Assessing the efficiency of commercial banks in Angola vs. Africa: A DEA approach*

In the Angolan context, there is not much literature on the evaluation of production units using a DEA approach, and it is even less extensive when the topic is related to the evaluation of the efficiency of commercial banks, as mentioned in the introduction. The literature review allowed us to subdivide the studies into five groups, taking into account the type of DEA models used, namely: radial (VRS and CRS), Malmquist-DEA, B-Convexity, Fuzzy-DEA and Stochastic-DEA. To present the context of the use of DEA models in the evaluation of commercial banks in Angola, the main ideas contained in the reviewed articles are presented below. The bibliometric analysis did not allow us to find any DEA study that had analyzed the efficiency trend in the Angolan banking sector using a DEA window approach. In this sense, studies such as those by (5) (7) (8) evaluate the relative efficiency of banks in Angola using DEA CRS and VRS models. In these studies, based on a financial intermediation approach, the authors generally develop the research in two phases, first obtaining results from the CRS model and in second from the VRS model. In the Angolan context, studies using modified DEA models in the evaluation of banks appear in studies by Barros, Liang and Peypoch, (4) using an innovative production frontier model, the B-Convexity model, where the results indicate that efficiency increases over the observation period, taking into account international experience, market share and local markets; (21) who used the Fuzzy-DEA and Stochastic-DEA models to assess how the randomness and imprecision underlying the data interfere with efficiency levels; (6) used a Bayesian stochastic frontier model to analyze the differences in efficiency between foreign banks, public banks, large banks and banks belonging to a local conglomerate; (3) who used the Malmquist-DEA model to identify the productivity growth of Angolan banks.

In a complementary manner, other studies on the analysis of the efficiency of banks in Africa were reviewed, which, due to their scope, could in some way reflect the state of the art about the evaluation of banks from a non-parametric approach (DEA). Such were the cases of (22), where the efficiency of African banks, included in the top 100 of the African Business magazine of 2006. The study makes an analysis based on the CRS and VRS models, which allowed the identification of reference pairs between the banks and a sensitivity analysis that allowed the identification of slack in the optimization of the variables; (23) which estimated the relative efficiency of 58 commercial banks, belonging to 5 East African countries, applying radial models (CRS and VRS), and arriving at results that indicate that the source of inefficiency revealed, originates in the process of resource optimization; (24) who assessed the financial and social efficiency of 18 small banks from 8 member countries of the Southern African Development Community (SADC), where, from a production approach, they used an input-oriented DEA VRS model, which allowed obtaining results that point to higher financial efficiency indexes than social efficiency indexes; (25), it was reviewed as a reference to Mozambique, with characteristics similar to Angola, with regard to the configuration of the economic-financial system (countries speaking the same language, independent in the same year, opted for centralized production systems after independence, which also changed in the same phase to market economies). The study assesses the efficiency of 16 commercial banks operating in Mozambique, based on a non-radial VRS model based on slack, oriented to output (SBM-O). The results obtained revealed an average lower than 1, which generally classifies Mozambican commercial banks as inefficient.

2.3. *CRS and VRS models: An overview*

The review of the evaluation of commercial banks in Angola and the reviewed African countries makes evident the predominance of the use of radial DEA models (CRS and VRS).

The CRS and VRS models frequently appear in research on banking efficiency, given their ability to capture changes in banks' operational processes.

Considering the dynamic environment in which banks operate, the VRS model is often used since scale can have an impact on productivity, while the CRS may be suitable for global efficiency comparisons. In the study, the choice of models was based on the objectives of the analysis, i.e., the two radial models presented were adopted.

The possibilities offered by DEA as a methodology that allows for the assessment of efficiency have been the basis for several studies related to the evaluation of commercial banks. This

tool is particularly important in the Angolan context, where aggregated data on the performance of small banks are difficult to access and are not always validated by an independent entity, which is particularly relevant in the case of small banks.

The evaluation of efficiency, based on the radial DEA methodology, allows the isolation of particular effects, related to how the management of banks, as well as the context in which they operate, influence their performance, which is why it becomes even more relevant when it comes to the evaluation of small banks in Angola. Thus, based on evaluations of observed data, DEA provides a post-factum view, useful for future findings and corrections that may contribute to improving the optimization levels of commercial banks in general and of smaller banks in particular. From this point of view, DEA as a methodology, composed of techniques and models, aimed at evaluating the efficiency of DMUs, finds in the radial models (input or output-oriented), its initial versions which are the subject of review in this study, namely: the CRS and VRS models, initially proposed by (26).

Considering the justification that appears in the topic related to the research methodology, only the mathematical formulations for the input guidelines will be presented, starting from (27).

In the context of DEA, radial models are represented by a group whose orientation is constituted by the input/output matrix, and in these models, the condition is assumed that the inputs must be minimized and the outputs maximized (28). The aforementioned condition defines that the variations that occur in the quantity of one of the components of the input/output matrix are directly proportional to these, that is if the quantity of input varies by one unit, the same variation will occur in the output and vice versa, if constant returns to scale are considered.

According to (29) the CRS model, it represents a generalization of Farrel's definition (1957), based on the construction of a non-parametric linear surface, involving the data.

The consideration of the assumption of constant returns implies the assumption that all DMUs operate at the same production scale, therefore, according to (30), the assumptions of the CRS model, based on the existence of a linear relationship between inputs and outputs, are only justified when all DMUs are operating at an optimal scale.

The mathematical formulations for the CRS and VRS models were taken from (27).

Considering that the restrictions applied to DEA models presuppose the consideration of maximum and minimum values, for the formulation of the CRS model with input guidance, we have that:

$$\text{Maximizer } h_k = \sum_{r=1}^s u_r y_{rk} \tag{1}$$

Subject to:

$$\sum_{r=1}^m u_r y_{rj} \tag{2}$$

$$\sum_{i=1}^n v_i x_{ik} = 1 \tag{3}$$

$$u_r, v_i \geq 0 \tag{4}$$

Where: y: inputs; x: outputs; r: 1, ..., m; i: 1, ..., n; j: 1, ..., N.

Similar to other simplified representations of reality, the DEA technique, to solve the problem of calculating efficiency in companies, underwent several changes with the inclusion in the initial model of the condition of non-constant returns (8).

In this sense, the VRS model differs from the CRS model in the type of predicted returns, this means that the variations that occur in one of the components of the input/output matrix do not result in a proportional variation in any of the components (input or output) of the matrix, that is, in this model the returns are variable.

The model measures the resulting combination of observed values for inputs and outputs, under the condition that, not being constant, the returns to scale assume the conditions of: increasing, constant or decreasing (31).

Among some of the reasons that lead to the adoption of models that predict variable returns to scale is the observation of negative values in both inputs and outputs, in addition to there being differences between DMUs, in their operational context, resulting from changes in the technology used, in regulatory aspects or in the financing conditions of their activities, causing the premise of observing constant returns to be questioned.

Given the maximum and minimum constraints, the formulation of the input-oriented VRS model is as follows:

$$\text{Maximizer } h_k = \sum_{r=1}^m u_r y_{rk} - u_k \tag{5}$$

Subject to:

$$\sum_{i=1}^n v_i x_{ik} = 1 \tag{6}$$

$$\sum_{i=1}^m u_r y_{rj} - \sum_{i=1}^n v_i x_{ij} - u_k \leq 0 \tag{7}$$

$$u_r, v_i \geq 0 \tag{8}$$

Wherw: y: inputs; x: outputs; u e v: pesos; r:1,..., m; i:1,..., n; j:1,..., N.

However, like any methodology, DEA also has limitations in its use for evaluating efficiency, some of which can be highlighted:

Because it is a linear programming technique, DEA observes each input and output only once, which can cause errors in its data, leading to biased results, since they can represent either efficient or falsely efficient solutions (12);

Lack of discriminatory power between DMUs. This disadvantage of DEA is also mentioned by (32), who states that degeneration is a very common problem in DEA models, due to the very structure of their linear programming problems, where there is a large number of redundant constraints related to inefficient DMUs and which, in some cases, causes there to be multiple optimal solutions;

According to (33) there is a consensus among operations research scholars that, because they do not estimate efficiency scores around an average, DEA models are sensitive to outliers and computation errors.

2.4. DEA Window

The dynamics in the trend of companies' efficiency records can reveal their causes and indicate directions for improving their performance, therefore, to capture the trend of efficiency scores of the two models presented (CRS and VRS), the DEA window analysis technique was used.

In addition to not requiring any assumptions to be made about the distribution of the data, another of the main advantages of DEA is that it works relatively well with small samples. (34), a situation verified in this study.

The DEA window technique consists of grouping the DMUs belonging to a given sample into overlapping analysis windows. This procedure allows the sample to be subdivided according to the principle of moving averages, which allows new data to emerge in each window.

DMU _k		Periods							E _r
		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	
Windows	Window 1	E _{1 1}	E _{1 2}	E _{1 3}					E _{1*}
	Window 2		E _{2 2}	E _{2 3}	E _{2 4}				E _{2*}
	Window 3			E _{3 3}	E _{3 4}	E _{3 5}			E _{3*}
	Window 4				E _{4 4}	E _{4 5}	E _{4 6}		E _{4*}
	Window 5					E _{5 5}	E _{5 6}	E _{5 7}	E _{5*}
E _{rj}	Column Average	E _{*1}	E _{*2}	E _{*3}	E _{*4}	E _{*5}	E _{*6}	E _{*7}	E _{**}

Figure 1. Default DEA window configuration (35)

The DEA window technique is a dynamic analysis that observes selected DMUs over a period of time, which allows for the increase in analyzed DMUs (36).

Based on the ideas contained in (37), about the configuration of the (X_{kw}) input and output matrices (Y_{kw}) of each window (kw), these can be presented in the following forms:

$$X_{kw} = \begin{bmatrix} x_1^k & x_2^k & \dots & x_N^k \\ x_1^{k+1} & x_2^{k+1} & \dots & x_N^{k+1} \\ \vdots & \vdots & \ddots & \vdots \\ x_1^{k+w} & x_2^{k+w} & \dots & x_N^{k+w} \end{bmatrix} \tag{9}$$

and

$$Y_{kw} = \begin{bmatrix} y_1^k & y_2^k & \dots & y_N^k \\ y_1^{k+1} & y_2^{k+1} & \dots & y_N^{k+1} \\ \vdots & \vdots & \ddots & \vdots \\ y_1^{k+w} & y_2^{k+w} & \dots & y_N^{k+w} \end{bmatrix} \tag{10}$$

According to (38) in the analysis that applies the DEA window technique, carried out type analysis $(k - p + 1)$ separated, in which each analysis examines new DMUs where; n : number of DMUs; k : number of periods to which the data refer; p = window width ($p \leq k$) and w : number of windows, i.e. there are n DMUs \times k (number of periods). Thus, Table 1 presents the mathematical formulations related to the operationalization of the DEA window analysis.

Based on the information contained in Table 1, in the topic referring to the methodological paths followed, the procedures adopted to define the width of the analysis windows are presented, as well as their justification, that is, the largest possible number of different DMUs.

3. Materials and Methods

To analyze the dynamics of efficiency, in this article, the two radial models presented (CRS and VRS) were used, both with input orientation. The orientation given to the models arises from the consideration that inputs are the variables over which companies have the greatest capacity for rationalization and, consequently, optimization.

The CRS model was used with the intention of capturing the trend of efficiency scores in the process of combining productive resources by the banks analyzed, while the VRS model was used to capture the effect of the technology used on their efficiency throughout the period analyzed.

Considering the theoretical assumptions for determining the width of the analysis windows, contained in (38) and presented in Table 1, a window width of four years was adopted. This procedure allowed a considerable increase in the number of different DMUs, as opposed to the 9 (8) = 72 DMUs that would be available if the evaluation had been carried out separately for each of the DMUs in each of the eight periods. Thus, the configuration of the analysis windows, presented in Table 2, allowed an increase in the discriminatory power for 180 different DMUs analyzed, as demonstrated in Table 1.

To select the variables targeted for analysis, the typology of variables provided for in the financial intermediation approach was considered, seeking a balance between the number of inputs and outputs about the number of DMUs, to obtain a good discriminatory power of the efficiency scores, throughout the analysis windows, allowing the number of efficient DMUs to be as small as possible in each analysis window. Like other less advanced countries, whose economies are in a phase of transition towards industrialization, the Angolan financial system is mainly made up of commercial banks, whose basic function is to capture deposits and grant loans, a view corroborated by (39) the fact that this approach is particularly appropriate for banks whose basis of operations consists of transforming deposits and funds acquired from other financial institutions into loans and financial investment.

In this sense, the rule suggested by was applied (40), according to which the number of DMUs analyzed must be at least twice the total number of inputs and outputs selected.

Still aiming to give greater discriminatory power to the efficiency scores obtained, a correlation test was carried out in order to guarantee a selection of variables with a lower degree of association between them, and therefore, with greater explanatory capacity between them.

Table 1. Criteria for defining the width of analysis windows

Window specifications	Formulas	p = 4 years	p = 5 years
Number of windows	$w = k - p + 1$	$8 - 4 + 1 = 5$	$8 - 5 + 1 = 4$
Number of DMUs in each window	$(n) (p)$	$9 (4) = 36$	$9 (5) = 45$
Number of different DMUs	$(n) (p) (w)$	$(9) (4) (5) = 180$	$(9) (5) (4) = 180$
Variation in the number of DMUs	$n (p - 1) (k - 1)$	$(9) (3) (7) = 189$	$(9) (4) (7) = 252$

Considering the premises presented for the configuration of the DEA windows, the configuration presented in Table 2 was considered.

Although a window with a width of five years also allows obtaining the same number of different DMUs, it is in the case where $p = 4$ years that the number of DMUs registers a lower value in its variation, indicating greater stability in terms of the results to be obtained in this condition, that is, opting for a window with a width of 4 years obtains a variation in the number of different

DMUs, 72% lower compared to the variation that occurs when the adopted window is 5 years, as shown in table 1.

Table 2. Analysis window configuration

Periods	1	2	3	4	5	6	7	8
Window 1	2016	2017	2018	2019				
Window 2		2017	2018	2019	2020			
Window 3			2018	2019	2020	2021		
Window 4				2019	2020	2021	2022	
Window 5					2020	2021	2022	2023

4. Data and Variables

The decision to analyze only small banks finds its theoretical justification in studies by (15), allowing the analysis of the efficiency trend of banks with a relatively low volume of assets, regardless of their profitability, in the period studied. As in most evaluations within the scope of nonparametric DEA modelling, the generalization of the results obtained will be carried out within the strict scope of the sample, since a post-factum evaluation is carried out, that is, carried out based on data already observed, for each of the variables.

Data relating to the economic and financial performance of nine Angolan commercial banks were analyzed, with all published data referring to the period analyzed (2020-2023). Banks whose volume of assets does not exceed AOA 250,000,000 were analyzed, as illustrated in graph 1.

The data were obtained from the reports and accounts of the respective banks, from publications on their official websites, appearing referenced in: (41) (42) (43) (44) (45) (46) (47) (48) and (49), as shown in Table 3.

Table 3. The set of banks analyzed

Acronym	Designation	Established	Swift code
BCA	Banco Comercial Angolano, S.A.	1999	COMLAOLU
BE	Banco Económico, SA	2002	BESCAOLU
BNI	Banco Internacional de Negócios, S.A.	2007	BNICAOLU
BCH	Banco Comercial do Huambo, S.A.	2010	BCHUAOLU
BVB	Banco Valor, S.A.	2010	BVBXAOLU
YETU	Banco YETU, S.A.	2015	YETUAOLU
BCS	Banco de Crédito do Sul, S.A.	2015	CDTSAOLU
BIR	Banco de Investimento Rural, S.A.	2015	BIRVAOLU
BOCLB	Banco da China Limitada - Luanda	2017	BKCHAOLU

The data that make up the sample analyzed are covered by the period 2016-2023 and belong to Angolan commercial banks, which in the ABANC (Angolan Banking Association) classification (50), do not appear in the top ten positions, more specifically with an asset value not exceeding. Therefore, banks whose equity value is less than AOA 250,000 were included in the sample, as shown in graph 1.

According to (15), except after long periods of growth, mergers and acquisitions, small banks can become large, so, since the period analyzed is relatively short, it would not be expected that the impact of these on the efficiency of banks would be significant.

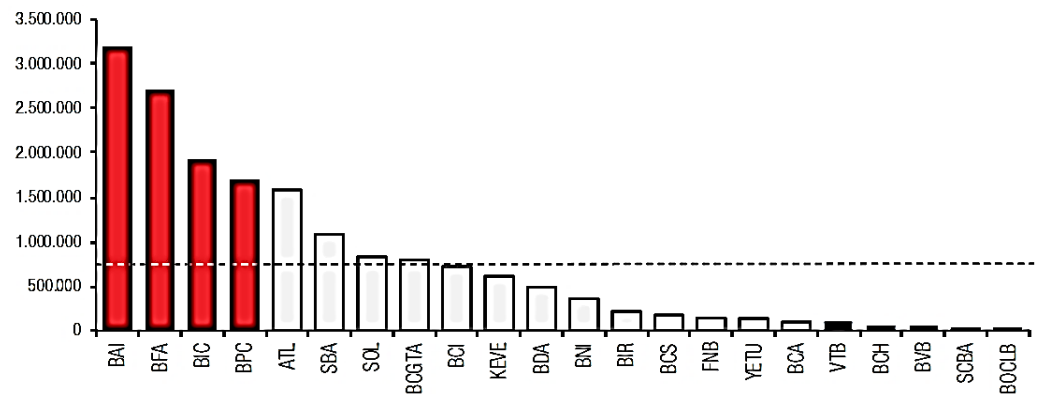
In this sense, during the time interval analyzed (2016-2023), the banking system registered some mergers and acquisitions between smaller banks, this being the main basis for the temporal delimitation of the research. This occurred between the banks Standard Chartered, S.A. and Finibanco Angola, acquired by Access Bank Plc., from Nigeria, in 2022, Banco Atlantico (established in 2016, as a result of the merger between Banco Privado do Atlantico and Millenium BCP Angola) and Banco da China Limitada - Luanda (established in 2017, as a result of the establishment of commercial relations at an institutional level between the Republic of Angola and the People's Republic of China), according to the information contained in (51) and (52), respectively.

Finally, VTB Africa bank, due to the absence of published financial statements in 2023, was also not analyzed. However, since, within the scope of DEA, it is an assessment of the relative

efficiency of DMUs, the results were not affected, since their scope is exclusive to the banks included in the sample.

The restriction of the sample to a smaller universe, with the exclusion of larger banks, produced repercussions on its size. However, the overlapping windows technique allowed the increase of different DMUs, as mentioned in the topic related to the DEA window.

The criteria followed by (50), to classify the set of commercial banks existing in the Angolan financial system, the size of their assets is considered as the main indicator, as can be seen in graph 1.



Graph 1. Size of credit financial institutions by assets in AOA '000 (50)

At the time of preparation of this study, the available data referred to the year 2023. The time horizon of the report is also relevant, as it coincides with a period of restructuring and mergers that gave rise to new banks, namely: BE, BVB and BIR. In line with the literature consulted, namely, (53) and (34), the following variables were adopted as output (loans to customers and operating revenue excluding interest) and as input (customer deposits and personnel costs).

Thus, in Table 4, the descriptive statistics of the mentioned variables are presented, highlighting the presence of extreme minimum values, however compatible with the standard deviation indicators, which in the set of variables, did not exceed half of the values of the corresponding averages.

Table 4. Descriptive statistics of variables (in AOA '000)

Variables	Minimum	Maximum	Average	St. Deviation
Deposits {I}	1	1,589,389,247	191,075,688	349,312,843
Personnel costs {I}	415	16,807,226	4,274,780	4,256,062
Loans {O}	1	178,818,324	33,126,499	45,113,393
Operating profit without interest {O}	232	178,470,270	16,373,725,640	34,547,148
Deposits {I}	1	1,589,389,247	191,075,688	349,312,843

The results, which appear in Table 5, provide information that there is a positive correlation between the input and output variables. They also provide evidence of the independence between the input variables, which is the same for the output variables, ensuring the appropriate level of robustness in the efficiency scores obtained.

Table 5. Correlation matrix between input and output variables

Variables	Deposits	Personnel costs	Loans	Operating profit without interest
Deposits	1,000			
Personnel costs	0.865	1,000		
Loans	0.684	0.762	1,000	
Operating profit without interest	0.867	0.775	0.531	1,000

5. Results and Discussion

The results were obtained using the Efficiency Measurement System (EMS) program (54). Table 6 presents an overview of the scores obtained for each of the banks in the sample, in each year and for each of the proposed models.

The scores represent the efficiency averages for each of the years and for the years as a whole (2016-2023).

In alignment with (55), the results obtained were as expected, since the scores under the VRS assumption are greater than or equal to those obtained under the CRS assumption.¹

Table 6. Overview of efficiency scores obtained

Model	Year	BOCL									Mean
		BCA	BE	BVB	YETU	BCS	B	BIR	BCH	BNI	
CRS	2016	13%	18%	9%	6%	7%	100%	3%	57%	23%	26%
	2017	26%	25%	19%	15%	41%	51%	9%	80%	26%	32%
	2018	69%	74%	19%	47%	72%	8%	100%	30%	50%	52%
	2019	72%	83%	17%	50%	67%	1%	34%	87%	41%	50%
	2020	3%	59%	35%	64%	100%	100%	66%	77%	55%	62%
	2021	14%	86%	26%	97%	45%	84%	47%	50%	62%	57%
	2022	7%	14%	37%	92%	45%	76%	30%	29%	46%	42%
	2023	11%	100%	18%	49%	30%	26%	32%	34%	51%	39%
	Mean	27%	57%	23%	53%	51%	56%	40%	56%	44%	45%
VRS	2016	85%	100%	39%	22%	71%	100%	100%	99%	100%	80%
	2017	67%	100%	36%	29%	62%	100%	99%	100%	94%	76%
	2018	100%	100%	29%	69%	100%	48%	100%	48%	100%	77%
	2019	100%	100%	27%	64%	97%	43%	46%	100%	76%	73%
	2020	13%	64%	38%	66%	100%	100%	79%	88%	92%	71%
	2021	20%	89%	36%	98%	50%	86%	58%	74%	100%	68%
	2022	21%	21%	41%	100%	60%	87%	33%	57%	99%	58%
	2023	19%	100%	38%	53%	59%	61%	39%	62%	100%	59%
	Mean	53%	84%	36%	63%	75%	78%	69%	79%	95%	70%

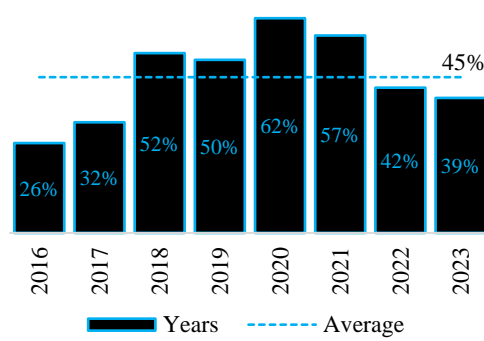
The period analyzed covers the beginning and end of an economic recession, which lasted around five years and which, from 2021 onwards, began to slow down, with signs of economic growth beginning in 2022 (56). This scenario had a structural impact on the performance of the banking sector in Angola, mainly due to the impact of the depreciation of the exchange rate on the financial results of banks, which may be the reason why none of the banks analyzed recorded average efficiency values between 2016 and 2023. This finding is supported by (57), according to which, in 2019, in the Angolan banking sector as a whole, as a result of the 73% drop in exchange rate results, net results also decreased, as did overdue loans, which increased by 34 % in the same period. Some of the strategies adopted were precisely the restructuring of the banks' shareholder structures, either through mergers or acquisitions, as mentioned.

5.1. Pure technical efficiency

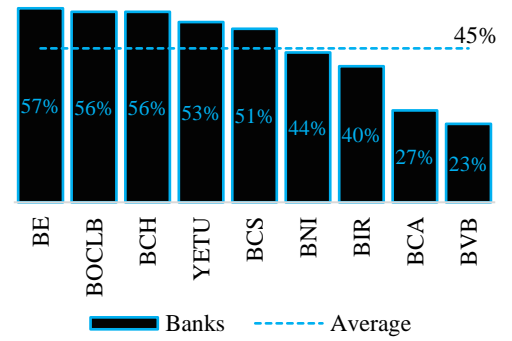
Graphs 2 and 3 show the pure technical efficiency scores, by bank and year. Thus, from graph 2, it can be seen that the variations around the average, for all banks in the sample, registered their lowest point in 2016 and their highest point in 2020. These variations revolve around an average of 45%, still below the 50% that would be half the efficient average. A visual inspection of graph 3 confirms this, allowing us to see that, during the period analyzed, no bank in the sample was efficient, with BE being the least inefficient.

The results obtained are in line with those presented in (56) and (57), coinciding with the periods of lowest net results in Angolan banking.

¹ An overview of these results can be found in appendices A and B at the end of the text.



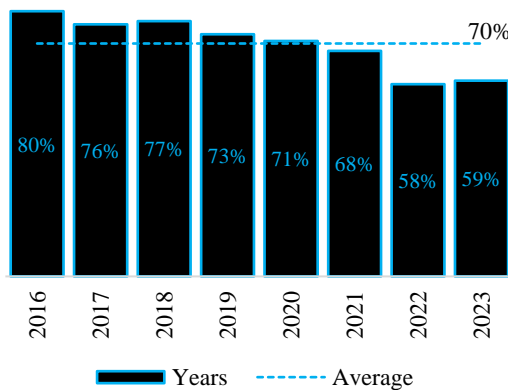
Graph 2. CRS vs. Average efficiency (years)



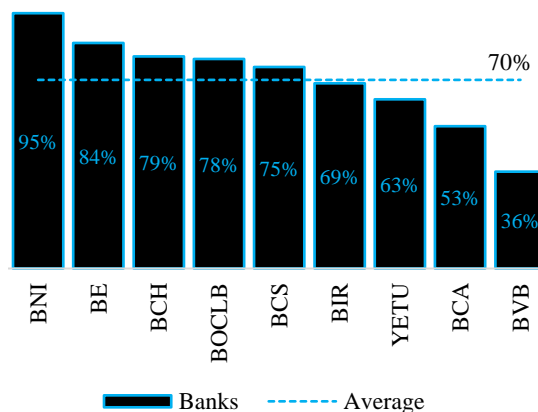
Graph 3. CRS vs. Average efficiency (banks)

5.2. Technical efficiency of scale

From the observation of the results of technical and scale efficiency, presented in graphs 4 and 5, it is possible to verify that, despite being equally inefficient over the years and for all banks, the average scale efficiency score is 25% higher than the average recorded in pure technical efficiency. This result is due, in part, to the fact that more than half of the banks analyzed recorded efficiency scores above 74%, that is, very close to the efficiency frontier, indicating that about half of the banks analyzed operate close to their optimal size.



Graph 4. VRS vs. Average efficiency (years)

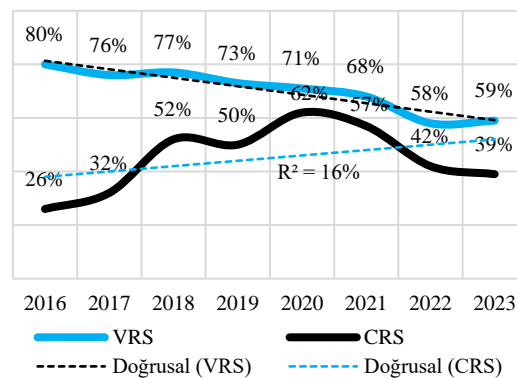


Graph 5. VRS vs. Average efficiency (banks)

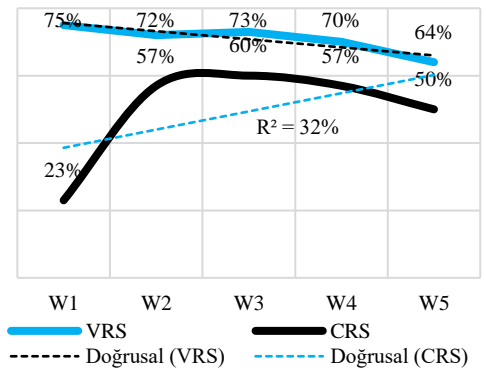
5.3. Comparative analysis between pure technical efficiency and technical efficiency of scale

Regarding the combined analysis of the trend of pure technical efficiency and scale efficiency, two important points are worth highlighting: first, the CRS model allows us to evaluate the performance of DMUs in the process of optimizing productive resources; and second, the VRS model allows us to evaluate the performance of DMUs in the process of optimizing available technological capacity. Thus, from graphs 6 and 7, it is possible to observe that, throughout the period analyzed, the VRS curve presents average efficiency scores that are higher than those recorded in the scores that make up the CRS curve. This behavior of the two curves indicates that, on average, the set of banks analyzed recorded better performance in indicators related to the optimization of the technological capacities installed in the sector, as well as the size of their operations. In contrast, the lower average performance recorded in the CRS scores indicates that the greatest sources of inefficiencies recorded in the period and for the banks analyzed are related to probable operational failures related to their management processes.

However, the trend lines of the two efficiency dimensions analyzed point to long-term convergence, beyond 2023. This convergence trend, which begins in the middle of the second window, is explained by the beginning of a downward trajectory in the average efficiency scores, both for pure efficiency (CRS) and for scale efficiency (VRS), from the beginning of the third window. Finally, it is worth noting that, despite always recording higher scores than those recorded for pure efficiency scores, the trend in the scale efficiency score curve was always in the direction of its decrease.



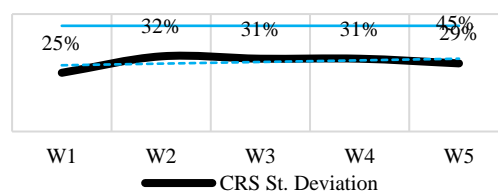
Graph 6. Efficiency averages per year



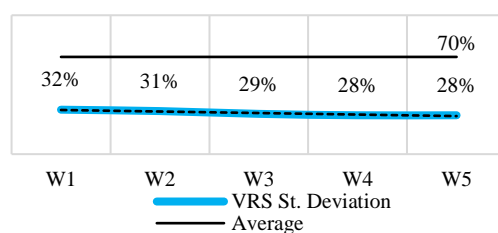
Graph 7. Efficiency averages per window

As expected, the trends in efficiency scores appear more linear across the five analysis windows. However, in graphs 8 and 9, the idea of an upward trend in pure technical efficiency scores and a downward trend in technical efficiency scores is reinforced, albeit more gently, in the perspective between the windows presented.

Considering the minimum and maximum values for the deviations in the efficiency scores, both pure and scale, whose results appear in graphs 8 and 9, it is possible to observe that the level of variation in the scale efficiency scores is greater than that recorded in the variations in the pure efficiency scores. This is evident by the record of higher standard deviations and, therefore, further away from the average of the efficiency scores (70%). These records may also indicate the existence of a greater degree of uncertainty regarding the trend of evolution of the pure efficiency scores, for the set of banks analyzed, in the coming years.



Graph 8. Deviation from mean efficiency (CRS)



Graph 9. Deviation from mean efficiency (VRS)

Unlike efficiency scores obtained annually, those obtained on a window basis allow for smoothing the records in the distances between the efficiency scores and their averages. This procedure allows for a more precise capture of the dynamic effects present, both in the trend of pure technical efficiency and in the efficiency of scale; an effect associated with the uncertainty present in the future behavior of the respective trends, which can serve as a predictive element for decision-making by the banks analyzed, both at the operational level and in defining the size of their business.

6. Conclusions and Observations

Although between the years (2016 and 2023) the average efficiency scores for the set of banks analyzed were 70% for scale efficiency and 45% for pure efficiency, the results obtained allowed us to identify that, while the evolution of pure technical efficiency scores tends to be decreasing, the opposite occurs with the trend in the evolution of technical scale efficiency scores. Thus, with a view to improving scale efficiency levels, one of the most suitable strategies is already underway, namely acquisitions and mergers, which allow for an increase in the volume of operations and a reduction in unit costs. However, corrective actions can be implemented, based on strategies that include: retaining and segmenting more customers to maximize revenue capture, improving financial management through capital restructuring, as well as taking advantage of new technologies to improve the customer experience in their relationship with new products and services provided by banks.

The analysis of the trend in the efficiency scores of nine of the smallest Angolan banks, in terms of the size of their assets, allowed us to identify a convergence between the levels of efficiency they achieved and the levels of risk associated with them.

Potentially, risks such as credit risks could be identified, precisely associated with their small size in terms of the assets they hold, to guarantee both the deposits they collect and the loans they grant.

Over the period analyzed, all banks recorded average scale efficiency levels higher than pure efficiency levels. However, the downward trend in scale efficiency indicates the need to develop actions to improve the optimization of the sector's technological capabilities.

The fact that pure efficiency recorded an average of 45%, 25% below the average for scale efficiency, also indicates that, in general, inefficiencies originate from banks' operational optimization processes, despite the record of an upward trend in their scores. Some of the strategies for improving pure technical efficiency would involve continuous training of employees to ensure greater results with the same resources, adoption of innovative practices that allow the automation of processes and consequent minimization of operational costs, in line with the input orientation of the models adopted in the study, or benchmarking. to adapt operations, aligned with the new and best trends in the sector.

In the period between (2016-2023) none of the banks were technically efficient, in any of the efficiency dimensions evaluated.

Being a preliminary study, the research does not cover all banks, as they do not belong to the group of the ten largest Angolan commercial banks, either due to insufficient data or due to changes in their ownership that led to the change of their brand.

As a line of action, it is proposed to use other measures that allow a better understanding of the performance of banks over time, such as: the Malmquist productivity index for benchmarking or the Luenberger index to capture operational constraints and external effects on bank management. The two measures applied to a larger sample could allow the identification of the causes that influence the performance trends of these banks, between different periods, namely the parallel and downward trajectory of the two efficiency dimensions from the third window onwards.

In terms of policies aimed at increasing banking efficiency, the assessment of only small banks in Angola, in the referenced period, can contribute to a more informed view of banking decision-makers, which allows decision-making, whose basis goes beyond the traditional standard profit

function, where only the profitability of banks is considered. In this sense, because the objective is the strict analysis of the average efficiency, based on numerical and statistical data, other aspects such as operational and strategic, which can allow a global analysis of the banks analyzed, such as: customer service, innovation, financial stability) were not taken into account, which presents itself as a limitation to the study and at the same time a direction for future research, based on sensitivity analysis, in order to provide a more detailed discussion on the validity and accuracy of the models used.

Funding: This research received no external funding.

Data Availability Statement: For access to data supporting results please contact to the authors of the article.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. CRS input orientation

Banks	2016	2017	2018	2019	2020	2021	2022	2023	Mean	St. Dev.
BCA	13.46%	12.17%	27.75%	24.01%					19%	8%
		38.90%	89.76%	87.75%	3.24%				55%	42%
			89.76%	87.75%	3.24%	13.09%			48%	47%
				88.14%	3.74%	13.12%	6.50%		28%	40%
Mean					3.74%	14.70%	7.45%	10.73%	9%	5%
	13.00%	26.00%	69.00%	72.00%	3.00%	14.00%	7.00%	11.00%	27%	28%
	17.72%	17.69%	48.31%	53.46%					34%	19%
		31.95%	81.17%	89.78%	56.48%				65%	26%
BE			93.11%	89.78%	63.63%	96.29%			86%	15%
				100.00%	65.95%	96.29%	13.97%		69%	40%
					51.30%	66.49%	13.44%	100.00%	58%	36%
	18.00%	25.00%	74.00%	83.00%	59.00%	86.00%	14.00%	100.00%	57%	34%
Mean	9.01%	10.04%	8.26%	7.01%					9%	1%
		28.65%	23.88%	19.31%	31.86%				26%	5%
			25.30%	20.52%	34.14%	24.05%			26%	6%
				22.92%	36.04%	24.27%	33.72%		29%	7%
BVB					38.14%	28.59%	39.65%	18.21%	31%	10%
	9.00%	19.00%	19.00%	17.00%	35.00%	26.00%	37.00%	18.00%	23%	9%
	5.99%	5.61%	13.23%	13.60%					10%	4%
		25.08%	63.40%	62.20%	63.64%				54%	19%
YETUI			63.40%	62.20%	63.64%	95.60%			71%	16%
				63.30%	64.57%	96.53%	88.77%		78%	17%
					65.82%	98.66%	95.39%	49.40%	77%	24%
	6.00%	15.00%	47.00%	50.00%	64.00%	97.00%	92.00%	49.00%	53%	32%
Mean	7.00%	20.49%	15.38%	17.83%					15%	29%
		60.59%	100.00%	83.08%	99.07%				86%	29%
			100.00%	83.08%	99.07%	43.16%			81%	29%
				84.09%	100.00%	43.31%	44.74%		68%	29%
BCS					100.00%	48.54%	44.81%	29.51%	56%	29%
	7.00%	41.00%	72.00%	67.00%	100.00%	45.00%	45.00%	30.00%	51%	29%
	100.00%	2.17%	0.45%	0.36%					26%	29%
		100.00%	9.99%	0.86%	100.00%				53%	28%
BOCLB			14.40%	0.86%	100.00%	80.17%			49%	27%
				0.87%	100.00%	85.40%	75.63%		65%	26%
					100.00%	85.40%	76.36%	26.25%	72%	25%
	100.00%	51.00%	8.00%	1.00%	10.00%	84.00%	76.00%	26.00%	56%	25%
Mean	3.08%	6.40%	100.00%	15.55%					48%	46%
		10.75%	100.00%	37.56%	60.65%				49%	38%
			100.00%	40.31%	64.82%	44.23%			49%	27%
				43.66%	73.85%	51.81%	31.89%		48%	18%
BIR					65.31%	45.41%	28.45%	31.50%	48%	17%
	3.00%	9.00%	100.00%	34.00%	66.00%	47.00%	30.00%	32.00%	48%	31%

	56.92%	59.59%	16.28%	49.26%					49%	20%
	100.00%	35.01%	100.00%	73.37%					50%	31%
BCH		37.50%	100.00%	73.37%	47.57%				48%	28%
			100.00%	73.48%	47.65%	26.82%			47%	32%
				89.07%	56.24%	31.43%	33.84%		46%	27%
Mean	57.00%	80.00%	30.00%	87.00%	77.00%	50.00%	29.00%	34.00%	45%	24%
	22.66%	19.31%	24.58%	17.39%					21%	14%
		33.35%	60.00%	44.62%	50.04%				47%	13%
BNI			64.00%	47.47%	52.95%	59.43%			56%	13%
				55.86%	63.22%	68.44%	46.57%		59%	13%
				53.83%	58.27%	46.10%	50.98%		52%	12%
Mean	23.00%	26.00%	50.00%	41.00%	55.00%	62.00%	46.00%	51%	44%	12%
Mean	26%	32%	52%	50%	62%	57%	42%	39%		
St Dev	31%	23%	32%	32%	35%	32%	29%	28%		

Appendix B. VRS input orientation

Banks	2016	2017	2018	2019	2020	2021	2022	2023	Mean	St. Dev
	85.35%	94.09%	100.00%	100.00%					95%	7%
		38.92%	100.00%	100.00%	5.76%				61%	47%
BCA			100.00%	100.00%	8.24%	16.44%			56%	51%
				98.54%	17.80%	20.93%	19.57%		39%	40%
					20.21%	22.78%	21.49%	19.29%	21%	2%
Mean	85.00%	67.00%	100.00%	100.00%	13.00%	20.00%	21.00%	19.00%	53%	39%
	100.00%	100.00%	100.00%	100.00%					100%	0%
		100.00%	100.00%	100.00%	65.50%				91%	17%
BE			100.00%	100.00%	65.50%	100.00%			91%	17%
				100.00%	67.65%	100.00%	21.06%		72%	37%
					59.34%	66.72%	20.46%	100.00%	62%	33%
Mean	100.00%	100.00%	100.00%	100.00%	64.00%	89.00%	21.00%	100.00%	83%	28%
	39.38%	42.32%	34.35%	25.85%					35%	7%
		30.26%	25.09%	20.05%	33.65%				27%	6%
BVB			27.44%	21.67%	35.33%	27.88%			28%	6%
				41.89%	38.10%	38.27%	37.03%		39%	2%
					45.88%	41.75%	44.03%	37.82%	42%	3%
Mean	39.00%	36.00%	29.00%	27.00%	38.00%	36.00%	41.00%	38.00%	36%	5%
	21.79%	24.36%	65.79%	62.22%					44%	24%
		33.68%	67.48%	62.99%	63.94%				57%	16%
YETUI			72.43%	64.15%	64.49%	96.36%			74%	15%
				65.89%	66.83%	96.68%	100.00%		82%	19%
					70.15%	99.58%	100.00%	52.59%	81%	23%
Mean	22.00%	29.00%	69.00%	64.00%	66.00%	98.00%	100.00%	53.00%	62%	28%
	71.25%	63.42%	100.00%	100.00%					84%	19%
		60.84%	100.00%	100.00%	100.00%				90%	20%
BCS			100.00%	97.68%	100.00%	50.18%			87%	25%
				90.18%	100.00%	51.06%	62.46%		76%	23%
					100.00%	49.15%	58.21%	58.75%	67%	23%
Mean	71.00%	62.00%	100.00%	97.00%	100.00%	50.00%	60.00%	59.00%	75%	21%
	100.00%	100.00%	2.85%	1.55%					74%	56%
		100.00%	40.76%	22.54%	100.00%				74%	40%
BOCLB			100.00%	47.86%	100.00%	85.54%			75%	25%
				100.00%	100.00%	86.13%	83.47%		74%	9%
					100.00%	86.53%	90.05%	60.98%	74%	17%
Mean	100.00%	100.00%	48.00%	43.00%	100.00%	86.00%	87.00%	61.00%	73%	24%
	100.00%	98.20%	100.00%	53.10%					88%	23%
		100.00%	100.00%	42.67%	82.59%				81%	27%
BIR			100.00%	43.29%	82.16%	59.60%			71%	25%

				43.88%	83.69%	59.62%	37.01%		56%	21%
					66.29%	53.84%	28.59%	38.71%	47%	17%
Mean	100.00%	99.00%	100.00%	46.00%	79.00%	58.00%	33.00%	39.00%	69%	29%
				99.17%	100.00%	39.63%	100.00%		85%	30%
				100.00%	46.35%	100.00%	75.71%		81%	25%
BCH				58.12%	100.00%	81.21%	58.58%		74%	20%
				100.00%	94.49%	79.36%	54.52%		82%	20%
Mean	99.00%	100.00%	48.00%	100.00%	88.00%	74.00%	57.00%	62.00%	78%	21%
	100.00%	93.24%	100.00%	80.43%					72%	9%
				94.92%	100.00%	77.09%	100.00%		70%	11%
BNI				99.66%	74.17%	89.56%	100.00%		67%	12%
				74.14%	90.23%	100.00%	100.00%		65%	12%
Mean	100.00%	94.00%	100.00%	76.00%	92.00%	100.00%	99.00%	100.00%	57%	8%
Mean	72%	69%	69%	65%	64%	61%	52%	53%		
St Dev	30%	29%	29%	29%	30%	28%	32%	27%		

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Determinant Factors in Contracting Health Insurance on the Romanian Market

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Abstract: Private health insurance represents a risk management method meant to reduce the financial burden related to medical issues. Covid-19 pandemic brought about an increase demand for health insurance products as concerns for the unexpected effects of unforeseen medical situation escalated and were also exaggerated by social media. The fundamental changes in the population mentality towards health (due to significant lockdowns and quarantines) caused an increase in the proportion of the personal budget destined for health protection and a development of the insurance market products, despite the contraction of the national economies. Based on a Romanian study covering the financial behavior of natural persons, the article is analyzing the conduct of persons when confronted with the negative psychological and physical effects of pandemic crisis. The authors intentions were to validate the correlations between the insurance policy and elements such as sources of information, client relationships, financial behavior using correlation and regression methods. Besides, the paper is determined to reveal whether the benefits of digitalization caused an improvement in the approach of natural persons to look after their medical situation's protection.

Keywords: Insurance; financial burden; health expenditure; resilience; awareness

1. Introduction

The COVID 19 pandemic has had a significant impact over the world economy and consequently on general welfare. As expected, the effects were of different intensity, strangely affecting vulnerable social categories from the point of view of the work accommodation and living conditions (Schwartz et al. 2022).

Romania has a state-owned mandatory insurance health system, similar with the ones existing in most European countries. In exchange for a monthly contribution of 10%, retained by the employer from the gross salary and paid directly to the public health fund, a person has access to a predefined set of medical services – including surgeries, prescriptions, or medical investigations, limited as number per month. The public system offers coverage both for the active population and for social cases – children, students, unemployed or retired persons generating strained situations for the budget as there has been a deficit of revenues in the last decade due to decrease of the active population in Romania. The public health system is also funded by the local authorities that are responsible for hospitals management. Over the last decade, the public hospitals have significantly increased their budget - for example one of the largest hospitals reached a budget of approx. 200 million euros in 2023, three times bigger than in 2013 (Mihalache G. 2023). Unfortunately, the public revenues allocated for the health budget are insufficient to cover the feeble health state of the population and therefore additional forms of financing are required especially when a person needs complex medical services. Governments are looking forward to increasing the contribution of private health insurance to the coverage of national health expenses and for the role in increasing the system capacity or supporter of health policy objectives (Colombo F, Tapany N. 2023). Even in the developed countries with extensive health systems, individuals look for better access to medical services, allocating time and money seeking to secure better services (Bonsang E, Costa-Font J 2023).

The offer on the private insurance market is more than generous for those interested in covering their losses, no matter what the country is under scrutiny. Even in developing countries – still dominated by motor insurance policies – the private health insurance is timidly gaining option

Citation: Siminica, M.; Naghi, L.E.; & Campeanu, C. (2025) Determinant Factors in Contracting Health Insurance on the Romanian Market. *Journal of Economics and Business Issues*, 5(2), 18-34.

Received: 26/04/2025

Accepted: 17/07/2025

Published: 31/07/2025

among the consumers of financial services, especially after SARS-CoV2 pandemic, offering support to the financing of the public system. For example, in Romania, the contribution of the private health insurance is around 1% and way below the European Union average which is around 5% (Campeanu C. 2023). As most of the state funded systems, the Romanian system suffers from chronic short funding, difficult access to basic medical services and sometimes significant delays in delivering the proper medical care. Such obstacles have opened the market for private medical services, which is still a growing sector, developing mostly in urban areas.. Health insurance products provided a solution, and the sector quickly became an important growth factor for the insurance industry.

The Romanian private health insurance sector registered a positive evolution in the level of gross written premiums and paid claims, reaching an increase of 35% in 2022 compared to the previous year, approx. 134 million euros due to pandemic and fiscal deductions offered to employers and employees (ASF 2022).

However, private medical services, even though they offer much better-quality services than the state, often come at a price hardly affordable for a regular employee. Still, in a very untypical insurance market, dominated by MTPL, which has created severe disruptions in the past (two main insurers with more than 60% market share, filled for bankruptcy over the last years) increasing the market share of private health insurance products would be beneficial and studies approaching determinants for contracting such insurances become more and more relevant. Even though the literature provides a series of papers tackling the health insurance products, no study has recently and specifically approached the sales determinants for health insurance within the framework of COVID-19 pandemic effects.

2. Literature review

The factors that influence the decision to purchase health insurance are multiple, determined by each person's perception of its usefulness, but also by socio-demographic conditions.

The Anderson model leads to three dynamics when it comes to acquiring a private health insurance policy: predisposing factors, enabling factors, and need. Predisposing factors can be characteristics such as race, age, and health beliefs. Socio-demographic factors like age, economic status or education tend to be decisive but there are also several influencing factors like marital status, incentives, fiscal benefits etc. The decision to buy private health insurance is determined by different factors - social (age, education, marital status), enabling (household income, medical expenses, or debt) and needs-based (health status) (Shi H et al, 2022). Other studies revealed that the employment status and type as well as public health insurance status may affect the decision to purchase private medical (Wan G et al, 2020).

Private health insurance

Having a basic level of information about risk management, people tend to contract a private insurance policy to get coverage for their exposures. According to different studies, there is a positive correlation between the risk acknowledged by the bearer and the level of insurance coverage searched for (Chiappori P.A. et al, 2010). Adverse selection and moral hazard models expect a positive relationship between risk and insurance; yet the most common finding in empirical studies of insurance documents is a negative correlation between the two elements (Doiron D, et al, 2008).

On the other hand, for the insurance market, asymmetric information and adverse selection may be the cause for setting up certain levels of insurance prices and insurance demand but the consumers preferences are always being incorporated in the underwriting process to ensure the welfare impact of the potential market interventions (Einav L, et al, 2010). The standard model of insurance, including health may be hard to explain if the consumers behavior is not present in the expected utility model of insurance, which supports the idea that the probability of an event is based strictly rationally on the historical data. Loss aversion, misunderstanding of probabilities, or increased access to the information on the internet must be taken into consideration as the last pandemic event showed us. As in the case of other types of insurance products, health insurance is purchased infrequently and may be difficult to assess – as consumers tend to hesitate in choosing a new product or the comparison of the prices and coverages being tough to perform due to intricacies of the highly customized insurance products. The dynamic feature of medical exposures that accelerates with age and chronic health conditions bring about a special interest of the insurance companies to prudently evaluate the probability of losses and adapt their pricing policy even though that would generate an increase in the insurance premiums and hence would generate a decrease in the demand of such product (Hendel I, Lizzeri A, 2003). The relation between risk and probability of contracting private health insurance is not always clear – not all the time the high-risk persons will ask for extensive but with substitute coverage the low-risk persons will choose not to purchase private insurance (Olivella P, Vera-Hernandez M, 2006). Even more, the consumers of private

health insurance are keener on reporting the purchase of an insurance than the people without private insurance. The younger they are, the more cognitive they are in terms of understanding and processing information about insurance options, the more visible is the determinant relation between this ability and the decision of insurance purchase (Fang, H, et al, 2008).

Distress level and the ability of evaluating the opportunity cost of a health insurance product (benefits vs costs of the insurance purchase) highly depend on the level of education, including financial education and determine the awareness of insurance utility. There are studies supporting the idea that a high level of education implies a higher level of income and thus a preference for private insurance products as consumers are interested in avoiding long queues in public hospitals and demand a certain level of privacy, such as private rooms (Buchmueller T.M., et al; Cobb-Clark D. A., et al 2016).

Private insurance may act as a mental comforter as risk aversion may determine persons to purchase a protection instrument for their peace of mind. Individuals preoccupied with healthy behaviors (less likely to smoke or more likely to exercise) are prone to purchase health coverage even though they are not the primary target of such a product as they represent a low risk for medical exposures (Cutler D.M. et al, 2008). Individuals that believe to be in control of their own life (known as internal locus of control people) are prone to access private health insurance as they are inclined to anticipate future needs and therefore pay attention to the health risk management and quality of care services (Bonsang E, Costa-Font J., 2022; Kesavayuth D., et al 2020). This is consistent also with other studies revealing the importance allocated for preventive health measures of the more active individuals (Cobb-Clark D. A., et al 2014; Schmitz H, 2001).

It is widely accepted that the pandemic has influenced the insurance industry, especially when it comes to health and life insurance products. In terms of common characteristics of the latest evolutions related to COVID-19 pandemic, there are usually two concepts that have become a constant in international debates- Health and Digital. While limited medical resources and their accessibility were largely discussed, there is no question that restrictive lockdowns have boosted digitalization and digital solutions in the financial sector. The Covid-19 pandemic ignited the necessity of the governments to have access to timely health expenses data to promptly adapt the national policies (Muller M., et al, 2023).

When it comes to insurance, it was little surprise that health insurances have gained the spotlight and started to become more relevant than before. Digitalization changed its status from strategic objective to an operational necessity of the companies to remain competitive on the market—the pandemic became a trigger to act faster than the expectations of the insurance companies (Malenkov Y., et al, 2021; Pauch D., Bera A., 2022). The use of technologies in insurance operations created higher expectations of the customers as flexible and permanent access to health insurance services was paramount in the first months of the pandemic. Adopting new digital systems strained the financial situation of the companies but brought about tremendous advantages for those able to switch in a short period to online services as the pressure to retain existing customers and attract new ones without the benefit of face-to-face interaction (World InsurTech Report 2020). The new trends in digital technologies proved to increase the insurance market undercurrents and transparency as well as accentuated the reduction in the transactions' costs (Cappiello A, 2020).

Using online documents triggered a number of amendments to national legal framework, whereas dealing with privacy issues, or archiving as the offsite procedures were impossible to implement in the aftermath of Covid-19 burst – social media sales channel, online services availability and facial recognition technology are only some of the positive “side-effects” of the pandemic (Keller B, et al, 2019; Reinartz W, et al, 2019; Porrini D, 2023; Naghi, Laura Elly, 2023).

FinTech and Insurtech became the innovative trademark of the financial sector – initial work of adopting digital technologies in the area of insurance intermediaries and regulation was developed in the claim settlement activities- enabling customers to have better experience with their insurance contract (Volosovych S, et al, 2021; Daqar M, et al 2020). Several advantages were observed both by the customers and employees of the insurance companies after implementation of Insurtech solutions – which brought up new opportunities on medium term, despite the tremendous costs involved: product innovation in the product design; reduction of information asymmetries and finer segmentation of the clients in the assessment stage; digitally stored contracts and increased involvement of the customer in the sales and distribution as well as fraud reduction and decrease of the processing time in the claims settlement department.

Digitalization

Digitalization refers to innovation, access to information in real time, it is about efficiency, cost reduction, is about improving an existing business process while reducing costs and taking advantage of the benefits of dealing with big data (Eling M., Lehmann M., 2018; Qi Y., et al 2022). Digital transformation implications are widely applied in the operational processes of insurance companies from the moment of potential customer contact until the moment of electronic payment of claims settled automatically by the companies' employees (Pauch D., Bera A., 2022; Eckert C.,

Osterrieder K., 2020). The process of digital transformation is an ongoing one, boosted by the immediate needs required by the restrictions during the pandemic. It has not started with the pandemic nor was it finished as the restrictions ended. Theoretically, enabling the process of acquiring a health insurance policy would trigger a growth in sales, a wider coverage along with expanding the reach to different social categories. However, making products like health insurance more accessible, putting them at “click distance” it is a problematic challenge that involves changes at multiple levels, digitalization being just one of them (PwC 2019, Deloitte, 2020).

A rather common effect of the pandemic is a raise of people awareness when it comes to potential health risk and the limitation of otherwise performant state-owned medical systems with wide coverage (especially in Europe). In some countries risk perception is relatively low, caused by several aspects like culture, history, etc. However, the diminishing sensitivity of individuals exposed to continuous high level of risks is one of the factors diminishing the interest in further protection as a supplementary form of risk will not impact them (Kahneman D., Tversky A). Second, the phenomenon of narrow bracketing, i.e., the tendency of individuals to consider risky choices rather separately than jointly, might similarly apply to decisions under background risk and might make subjects on more unrelated risk when deciding on investments (Read D., et al, 1999). Given that the impact of background risk is a priori unclear it is important to test it with data on actual behavior (Strobl R. 2022).

When an individual already has a form of medical insurance offered by the public system with mandatory contribution, acquiring a private health insurance policy seems to be influenced by a series of factors. Tax deductions were introduced in Romania but the measure’s impact on the industry is yet to be determined whereas some governments have cancelled the deductions with little impact (Rodríguez M., Stoyanova A, 2008).

Also, a factual situation is to be considered when a mandatory state health care system is in place. Having private health insurance as a matter of choice considered an adverse selection or a substitute framework. This means that the private insurer must bear the entire treatment cost. The substitutes framework is available in several European countries like Finland, Italy, Spain, but also in countries like Mexico, New Zealand and, to some extent, in Romania (Olivell P, Vera-Hernandez M 2022). In the case of substitutes framework, high-risk individuals are the ones to purchase supplementary health insurance if adverse selection is the basis of insurance, reflecting a positive correlation with the risk probability. On the other hand, in the case of advantageous selection, low-risk individuals are the first to contract private insurance. In other words, under the substitutes framework the sign of the correlation between the probability of purchasing private insurance and risk is positive in the presence of adverse selection and negative in its absence (Gottlieb D., Mitchell O.S. 2022) Even though not very common, marital status has also been found to influence the decision of contracting a private health insurance as a positive correlation was identified between the marital status and the intention to reach out and contract a health insurance to protect all the members of the family (Akokuwebe M. E. M., Erhabor E. S. 2022).

Consumer behavior

Using data, marketers can gain an understanding of how consumers choose products or services, the thought and/or emotional process behind those decisions, and what motivates them to choose one product instead of another. Consumers of varying age groups are often drawn toward different types of products. Culture and Background play a role in consumer behavior – the countries with low financial literacy are less inclined to make purchases that improve their welfare or of a group, such as their family. All consumers have buying habits that are linked to their interests, and this influences the final decision of consumption. Education represents also an important factor which influences the purchase of insurance products – as the discrepancy increases between the variety of insurance offer and the level of studies of the Romanian majority (Ioncică M, et al, 2012). Financial literacy programs implemented at international level brought about changes in the consumer behavior – as more and more individuals are exposed to proper explanation of financial concepts, the number of complaints on the insurance market decreases and the client relationship management is improved. If consumer behavior and the understanding of the insurance represent triggers for the decision to buy, there is no direct relation between these two factors and the intention to buy (Dragos S, et al, 2020).

Social factors, such as buyers’ income level, where they live, and their family dynamic, may play a role in the types of products and services they spend their money on. Interactions Within Community-Driven Environment is one of the social factors influencing the purchase of goods and services, including financial services. Consumers’ desire to fit in with their friends, peers, and coworkers often plays a role in their purchasing decisions. The income level of consumers correlates closely with their buying patterns. Whereas low-income consumers may be concerned with buying based on needs versus wants, high-income individuals often have more expendable income and, thus, may be inclined to buy products based on wants instead of needs. Studies conducted on

different types of services revealed that individuals with high contact services perceived confidence and social benefits as the most important advantages in assessing the level of service and personal involvement (Srihadi T.F., Setiawan D, 2015).

Experts agree that there are four main types of consumer behavior: complex-buying behavior, dissonance-reducing buying behavior, habitual buying behavior, and variety-seeking buying behavior. Studying these behaviors can help marketers understand the types of things that may, and may not, influence a purchasing decision. Understanding the factors that can influence a consumer to say yes instead of no can help in designing targeted marketing strategies. Cultivating long-term relationships with customers, especially in complex insurance contract represent a must condition for succeeding in retaining customers (Berry, L.L 2022).

Complex buying behavior occurs when an individual buys an expensive and infrequently purchased product. Consumers are often highly involved with this type of purchase, and they take time to research the significant differences between various brands. Complex purchases often involve a deep sense of buyer commitment based on their associated costs. For example, consumers may have such behavior in case of contracting a complex health insurance including various coverages (interventions, disability, accidents clause etc.). There is a correlation between risk aversion and the decision to purchase insurance based on the willingness to take upon financial risks (Eling M, et al 2021). Dissonance-reducing buying behavior occurs when a consumer is highly involved in the purchase of an item, but they have a hard time pinpointing the difference between various brands. The “dissonance” occurs when a consumer is worried, they will make the wrong choice and will regret their decision later. Habitual buying behavior happens when consumers purchase something on a regular basis, but they are not emotionally attached to a brand. This type of behavior may apply for compulsory type of insurance. Variety Seeking Buying Behavior happens when individuals decide to buy a different product in the same product line, such as from a new insurer, not because they were dissatisfied with their initial purchase, but because they want to try something new.

A March 2019 study by the Journal of Retailing and Consumer Services notes that payment methods can lead to upticks in consumer spending (Costa A, et al 2019). The speed and ease of how payments are made can also play a role - consumers are more likely to buy when a business accepts payment via an internet account. In contrast, consumers who prefer to pay using cash are more likely to restrict their spending because, from a psychological perspective, every purchase is interlinked with an actual parting with physical money.

Consumer behavior can be highly influenced by the marketing of the insurance companies, if they take care to include in their activity efforts to explain the complexity of insurance vocabulary in simpler words so that the level of understanding the specific concepts is improved and therefore a better awareness level of the consumers to financial exposures is reached.

The purpose of this research is to analyze the factors influencing the decision to take out private health insurance in Romania, assessing the impact of consumer behavior, information sources, perceived benefits and digital solutions on affordability and consumer preferences based on a national survey on consumer perceptions of financial markets that was conducted in 2022 at the national level. The study aims to inform the design of insurance products and optimize marketing and actuarial strategies considering changes brought about by the COVID 19 pandemic and financial market developments.

The paper analyzes the behavior of individuals confronted with the psychological and physical effects of the pandemic crisis, with a focus on the decision for private health insurance. Based on a Romanian study, the authors investigate the correlations between the decision to take out a health insurance policy and factors such as sources of information, customer relations and financial behavior, using statistical correlation and regression methods. The paper foregrounds fundamental changes in health attitudes in the context of the COVID-19 pandemic, highlighting how digitization and increased reliance on official information sources have influenced private health insurance consumption behavior. The study also explores the impact of novel factors such as the amplified effects of social networks and the increased allocation of financial resources to health protection.

3. Materials and Methods

Our research was based on a national survey concerning the consumers' perception towards financial markets, carried out in 2022 on national level, based on a sociologic inquiry (Siminică M, et al, 2022). The research comprised a representative sample of 1303 respondents, 626(48%) males and 677(52%) females, having an error margin of 2,71% with a level of trust of 95%. The sample is determined as shown in figure 1, by considering Romania's population as slightly over 18 millions.

$$n = N * \frac{\frac{Z^2 * p * (1-p)}{e^2}}{\left[N - 1 + \frac{Z^2 * p * (1-p)}{e^2} \right]}$$

N = population
 Z = Z score according to the level of trust
 p = standard deviation
 e = error admitted
 n = sample

Figure 1. Sample Determination

Out of 1303 people invited to answer aged above 18 years, just 379 persons were detailed in their replies concerning health insurance products. The structure of the target group is detailed in the following paragraphs.

To verify the reliability of the data collected through the questionnaire, we calculated the Cronbach's Alpha coefficient, resulting in the values in the following table:

Table 1. Cronbach's Alpha Coefficient

Reliability Statistics	
Cronbach's Alpha	N of Items
.556	11

The value obtained is low, but it is higher than the minimum threshold of 0.500, confirming the reliability of the data.

The control variables used for this paper are some of the general social variables: age, income, education.

We undertook to validate the following research hypotheses:

- H1: Consumers with adequate consumption behavior tend to contract facultative health insurance;
- H2: The information source directly influences the decision of contracting insurance products;
- H3: Consumers inclining to savings favor to contract facultative insurance products
- H4: The decision of contracting a certain insurance product is taking into consideration the benefits of the insurance products;
- H5: The agile process of contracting an insurance determines the decision of contracting.

In order to better analyze the correlations mentioned in the hypotheses, we will define the following variables:

Table 2. Analyzed variables.

Name variables	Symbol
<i>Dependent variables</i>	
Use of health insurance	UT
Use of health insurance in the last 3 years	UT_3Y
<i>Factorial variables of a behavioral nature</i>	
The consumption behavior index	ICC
The information sources index	ISI
The financial behavior index	ICF
The motive for choosing a particular insurer	MAB
The method of purchasing the insurance	MOD_A
<i>Factorial variables of a socio-demographic nature (control variables)</i>	
Age	Age
Education	Education
Income	Income

Promoting an adequate **consumer behavior** in financial services based on an efficient management of financial resources represents one of the main objectives of financial literacy projects. An equilibrated budget will ensure that the ordinary expenses are covered on a rational basis by the revenues obtained by the person. Unfortunately, the decision of consumption is not a rational one, being caused as mentioned in the previous section by different factors that generate an emotional response to an existing situation and subsequently an irrational expense.

For the analysis of the consumption behavior, we developed a **consumption index**, and a qualitative index based on a set of 3 questions addressed to the participants of the target group:

- For a future purchase of facultative insurance product, I am looking for at least 3 different offers (Yes/No)
- Usually, I read the information sent by the financial entities (insurance companies) that I am working with (Yes/No)
- I am aware of the deductions offered by the state for the health insurance products and private pensions (Yes/No)

We assign 1 point for positive replies and 0 points for negative replies or lack of replies. We cumulated the points into an aggregated consumption behavior index with values between 0 and 3.

The consumption behavior index (ICC) was computed for each participant of the target group using the method of aggregating individual results, as follows:

$$ICC = \sum_{i=1}^3 P_i$$

where: P_i – represents the scores obtained for each of the 3 questions used to assess consumer behavior.

The higher the consumption behavior index, the more adequate the consumption behavior of the consumers.

In order to evaluate the **financial behavior** of our analyzed target group, we inquired the participants about the following options:

- Are you an organized person in managing your income (Yes/No)?
- Are you trying to save on a regular basis, when possible (Yes/No)?
- Is it important for you to have short-term financial plan (Yes/No)?
- Do you save money only when you wish for a special something (Yes/No)?
- Are you an impulsive person, buying even when you cannot afford the expenditure (Yes/No).

Based on this set of questions we developed a **financial behavior index**. As expected, an adequate financial behavior implies affirmative replies to the first 3 questions respectively negative replies to the following 2 questions. Therefore, for the first 3 questions 1 point was allocated for affirmative reply and 0 points for negative reply whereas in the case of the last 2 questions, 1 point was allocated for negative reply and 0 points was allocated for affirmative reply.

The financial behavior index (ICF) was computed for each participant of the target group using the method of aggregating individual results, as follows:

$$ICF = \sum_{i=1}^5 P_i$$

where: P_i – represents the scores obtained for each of the 5 questions used to assess financial behavior.

The higher the financial behavior index, the more adequate the financial behavior of the consumers.

In the insurance industry, as in the case of other financial services area, the source of information used to take the decision of purchasing a product is of maximum importance. Lack of solid, trustful sources of information may generate biased decisions generating future financial losses as well as loss of trust of the consumer in the industry.

In order to assess the source of information used for health insurance purchase, we developed a **source of information index**, by addressing a question to the survey participants “where do you usually take your information before purchasing a financial product” with the following alternatives structured taking into consideration the importance/trustfulness of the source.

Table 3. Types of sources of information

Source of information	Points allocated
The advice offered by an authorized professional consultant	8
Web pages of financial institutions	7
Headquarters of the financial institution	6
Specialty press	5
Social media pages (Facebook, Twitter a.s.o.) of the financial institution	4
Forums	3
Relatives' advice, family advice	2
Facebook groups that I am part of	1
I do not buy insurance products/Do not know/ Do not answer	0

By aggregating the individual replies of the participants, we computed a source of information index that evaluates the level of trust in a certain type of source for information. **The higher the index, the more trust in reliable, professional types of sources.**

3. Results

3.1. Analysis of determinant factors for the purchase of health insurance products

Following the centralization of the questionnaire completed by 1 303 participants, it resulted that 379 people, representing 29.1% of the sample, had private health insurance, out of which, 205 people (15.7%) had such of insurance product for the last 3 years. The percentage of people who benefited from facultative health insurance during the COVID 19 pandemic was relatively low in Romania, being influenced by a multitude of factors, including the individual behavior and socio-demographic differences.

Based on the study, behavioral factors were analyzed using the following variables: consumption behavior index; index of information sources; financial behavior index; motive for choosing the insurer and method of purchasing the insurance.

Descriptive statistics indicators for these variables are presented in the following table:

Table 4. Descriptive statistics indicators for factorial variables

<i>Factorial variables</i>	Minimum	Maximum	Mean	Standard Deviation
The consumption behavior index (ICC)	0	3	1,65	0,952
The information sources index (ISI)	0	8	3,85	3,270
The financial behavior index (ICF)	0	5	3,92	1,049
The motive for choosing a particular insurer (MAB)	0	5	2,90	1,435
The method of purchasing the insurance (MOD_A)	1	2	1,12	0,456

The consumption behavior index was calculated by summing up the scores obtained from answering three questions. Each reply received individual values between 0 and 3 points. Following the centralization of the data from the applied questionnaires, we found that 71.2% of the individuals request at least three offers when purchasing private insurance, 62.1% read the information received from the insurance companies they collaborate with and only 26.7% are aware of fiscal tax deductions when purchasing a health insurance policy. The average value of the consumption behavior index was 1.65 points, higher than the median value of the scoring interval. Only 19.2% of the respondents had the maximum score (3 points), 41.1% obtained 2 points, while 25% registered 1 point and 14.7% 0 points.

According to our methodology, the information sources index registered individual values between 0 and 8 points, depending on the information source that each respondent preferred. Thus, only 12.97% of the respondents declared that they seek the advice of an authorized financial consulting company, obtaining the maximum score (8 points), another 22.1% obtain information from the websites of financial institutions (7 points), respectively 13.28% go to the institutions' headquarters (6 points). The average score of the information sources was 3.85 points, lower than the median value of the scoring range, determined by the large number of respondents who declared that they do not purchase financial products / do not know / do not answer (35.22% of the total, who received 0 points).

The financial behavior index measures people's tendency towards saving – investing. According to our methodology, individual values of financial behavior index range from 0 to 5 points based on 5 questions. The average level of the financial behavior index was 3.92 points - 88.9% of the respondents consider themselves organized people when it comes to money management; 89.3% stated that they try to save regularly; for 72.9% it is important to have a short-term financial plan while 51.9% do not agree to save only when they want something special, and 83.6% do not consider themselves impulsive people (they purchase products even when they cannot afford them).

The motive for choosing a particular insurer is important in making the decision to purchase a private insurance policy. Individuals who correctly understand the role of health insurance as a protection method against risks will be much more willing to purchase such a product. The evaluation of the motives for choosing a particular insurer was carried out by awarding scores from 0 to 5 depending on the stated reason. Depending on the importance the respondents who had ever purchased an insurance product allocated to different reasons, only 14.4% of the respondents considered the level of coverage (5 points) as primary reason, 26.4% took into consideration the price (4 points), 16.3% they considered the company's reputation (3 points), 25.1% were guided by their previous experience with the company (2 points), 11.4% were guided by a friend's recommendation (1 point) and 6.4% did not answer the question (0 points). Based on the individual values collected, the average score for this index was 2.90 points, higher than the median value of the scoring range.

The method of purchasing the insurance (either going to the headquarters of an insurance company / broker, respectively online, on the internet page of the insurer/broker or using an online store), represents another determinant – it can improve the sales by choosing the appropriate selling channel. 80.4% of respondents preferred to go to the insurance company/broker's office and only 14.8% bought their insurance policy online. Narrowing down the sample to individuals who purchased a health insurance policy, we found out that 21.6% of the sample purchased this insurance product online which reflects a greater interest in this method of purchase.

Socio - demographic factors also have a significant influence on the decision to purchase health insurance. Among them, for the study we selected three factors: age, education, and income level, and reached the conclusion (conforming other studies) that young people, with higher education or higher incomes have a higher degree of access to private health insurance than the average.

Under these conditions, we used these 3 variables as control variables for the statistical analysis of the factors that determine the decision to purchase health insurance. To analyze the dependence between the identified influencing factors and the decision to purchase health insurance, we used the correlation method and multiple linear regression.

3.2. Analysis of the correlation between the purchase of health insurance and behavioral factors

We computed Pearson correlation coefficient using the analyzed variables and obtained the following results - Table 5.

Table 5. Correlation matrix with behavioral factors.

		UT	UT_3 Y	ICC	ISI	ICF	MAB	MOD_A
UT	Pearson Correlation	1	. ^A	,160 **	,154 **	-,017	,028	,085 *
	Sig. (2-tailed)		,000	,000	,000	,573	,422	,016
	N	1142	379	1142	1142	1142	817	817
UT_3 Y	Pearson Correlation	. ^A	1	,086	,154 **	,047	,178 **	,124 *
	Sig. (2-tailed)	,000		,093	,003	,362	,000	,016
	N	379	379	379	379	379	379	379
ICC	Pearson Correlation	,160 **	,086	1	,222 **	,167 **	,102 **	,156 **
	Sig. (2-tailed)	,000	,093		,000	,000	,003	,000
	N	1142	379	1303	1303	1303	877	877
ISI	Pearson Correlation	,154 **	,154 **	,222 **	1	,079 **	,152 **	,134 **
	Sig. (2-tailed)	,000	,003	,000		,004	,000	,000
	N	1142	379	1303	1303	1303	877	877
ICF	Pearson Correlation	-,017	,047	,167 **	,079 **	1	,093 **	,058
	Sig. (2-tailed)	,573	,362	,000	,004		,006	,085
	N	1142	379	1303	1303	1303	877	877
MAB	Pearson Correlation	,028	,178 **	,102 **	,152 **	,093 **	1	,175 **
	Sig. (2-tailed)	,422	,000	,003	,000	,006		,000
	N	817	379	877	877	877	877	877

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Source: Processing with the help of SPSS

The obtained results show a direct relationship, statistically significant, but of low intensity, between the use of health insurance and the consumption behavior index ($R = 0.160$, $Sig = 0$), the information sources index ($R = 0.154$, $Sig = 0$), respectively the method of insurance purchase ($R = 0.085$, $Sig = 0.016$). This means that people who have an appropriate consumption behavior, requesting several offers when concluding an insurance, getting information from sources with a high degree of credibility and with a greater openness to purchasing insurance in the online system, have a greater willingness to purchase health insurance. Surprisingly, the use of health insurance does not correlate with the index of financial behavior, respectively with the motive for choosing the insurer.

In order to evaluate the change in consumer behavior during the COVID-19 pandemic, we analyzed the link between the use of health insurance in the last 3 years and behavioral factors. We found out that there is a direct, statistically significant, but of low intensity, relationship of insurance use in the last three years with the index of information sources ($R = 0.154$, $Sig = 0.003$), respectively with the method of purchasing insurance ($R = 0.124$, $Sig = 0.016$). Compared to the pre-pandemic period, over the last 3 years a positive, statistically significant, low-intensity link was identified with the motive for choosing the insurer ($R = 0.178$, $Sig = 0$), which means that during the pandemic people were much more careful to the risks covered when they decided to purchase

health insurance. The consumer behavior index and the financial behavior index do not correlate with health insurance use in the past 3 years.

3.3. Analysis of the correlation between the purchase of health insurance and socio-demographic factors

The results of Pearson correlation coefficient computed based on variables involved in the analysis may be seen in the following table.

Table 6. Correlation matrix with socio -demographic factors.

		UT	UT_3 Y	Age	Education	Income
UT	Pearson Correlation	1	. A	-.116 **	.221 **	.157 **
	Sig. (2-tailed)		.000	.000	.000	.000
	N	1142	379	1142	1142	1142
UT_3 Y	Pearson Correlation	. A	1	-.165 **	.133 **	.138 **
	Sig. (2-tailed)	.000		.001	.009	.007
	N	379	379	379	379	379
Age	Pearson Correlation	-.116 **	-.165 **	1	-.086 **	-.253 **
	Sig. (2-tailed)	.000	.001		.002	.000
	N	1142	379	1303	1303	1303
Education	Pearson Correlation	.221 **	.133 **	-.086 **	1	.294 **
	Sig. (2-tailed)	.000	.009	.002		.000
	N	1142	379	1303	1303	1303
Income	Pearson Correlation	.157 **	.138 **	-.253 **	.294 **	1
	Sig. (2-tailed)	.000	.007	.000	.000	
	N	1142	379	1303	1303	1303

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Source: Processing with the help of SPSS

The use of health insurance throughout life, but also during the pandemic, correlates with each of the socio-demographic variables included in the analysis. Thus, an inverse (negative) relationship, statistically significant, was identified between the use of health insurance and the age of the respondents. However, the intensity of this link is low ($R = -0.116$, $Sig = 0$ for UT, respectively $R = -0.165$, $Sig = 0.001$ for UT_3Y) which means that young people are more inclined to purchase private health insurance.

The use of health insurance correlates directly (positively) with the level of education ($R = 0.221$, $Sig = 0$ for UT, respectively $R = 0.133$ and $Sig = 0.009$ for UT_3Y) and with the level of income obtained by respondents ($R = 0.157$, $Sig = 0$ for UT, respectively $R = 0.138$ and $Sig = 0.007$ for UT_3Y). This means that an increase in the level of education (university studies), respectively an increase in the population's income, causes an increase in the willingness to purchase to health insurance. The identified correlations are statistically significant because the value of the Sig indicator is less than 0.01, but the strength of the link is reduced.

Socio-demographic variables are used as control variables. By identifying the link between them and the use of health insurance we validate the proposed analysis model.

3.4. The multiple linear regression model

The multiple linear regression model has the role of estimating the intensity of the influence of each factorial variable on the degree of use of health insurance. Based on the results of the pre-

viously performed correlation analysis, a multiple linear regression model is proposed for the analysis of the use of health insurance (UT), which includes 3 behavioral variables and 3 socio-demographic variables. The general form of the regression model is:

$$UT = \beta_0 + \beta_1 \times ICC + \beta_2 \times ISI + \beta_3 \times MOD_A + \beta_4 \times Age + \beta_5 \times Education + \beta_6 \times Income$$

To validate this model and determine its parameters, we used the SPSS software program, obtaining the following results:

Table 7. Model Summary 1

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
				R Square Change	F Change	df1	df2	Sig. F Change	
.234 ^a	.055	.048	.48696	.055	7,809	6	810	.000	1,941

a. Predictors: (Constant), Income, ISI, ICC, MOD_A, Age, Education

b. Dependent Variable: UT

Source: Processing with the help of SPSS

Table 8. ANOVA – model 1^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	11,110	6	1,852	7,809	.000 ^b
Residual	192,074	810	.237		
Total	203,185	816			

a. Dependent Variable: UT

b. Dependent Variable: UT

Source: Processing with the help of SPSS

The regression model obtained has a coefficient of determination $R^2 = 0.055$, which means that the factorial variables included in the model explain 5.50% of the decision to purchase health insurance. These data validate, from a statistical point of view, the results of the regression analysis, based on the p-value = 0.0000 (column Sig). A p-value lower than 0.05 gives increased validity to the results obtained from statistical data processing. Model parameters are presented in the following table.

Table 9. Coefficients – model 1

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		Collinearity Statistics		
	B	Std. Error	Beta			Zero-order	Partial	Parthian	Tolerance	VIV
1 (Constant)	.399	.122		3,281	.001					
ICC	.035	.021	.059	1,693	.091	.099	.059	.058	.952	1,050
ISI	.008	.006	.053	1,487	.137	.109	.052	.051	.913	1,095
MOD_A	.026	.039	.024	.661	.509	.085	.023	.023	.920	1,088
Age	-.072	.018	-.142	-3,934	.000	-.186	-.137	-.134	.895	1,117
Education	.049	.030	.061	1,676	.094	.115	.059	.057	.878	1,139
Income	.026	.016	.060	1,662	.097	.126	.058	.057	.885	1,130

a. Dependent Variable: UT

Source: Processing with the help of SPSS

For the statistical validation of the model, it is necessary to check the autocorrelation of the errors and the hypothesis of multicollinearity. The validation of the autocorrelation of errors was done using the Durbin-Watson test. It can take values between 0 (positive linear autocorrelation) and 4 (negative linear autocorrelation). If its value is close to 2, it means that there is no autocorrelation of errors. In the study conducted, the value of the Durbin -Watson test is 1.941, close to 2, which means that there is no autocorrelation.

The multicollinearity hypothesis was tested using the VIF indicator. It has values less than 5 for all variables included in the model, which means that there is no multicollinearity between the variables in the model.

Based on these tests, we validate the multiple linear regression model, in the form:

$$UT = 0.399 + 0.035 x ICC + 0.008 x ISI + 0.026 x MOD_A - 0.072 x Age + 0.049 x Education + 0.026 x Income$$

The obtained model confirms the direct correlation between the purchase of health insurance and the index of consumption behavior, the index of information sources, the method of purchasing insurance, the level of education and income, respectively an inverse correlation with age.

The greatest influence on the degree of access to health insurance is the level of education. Changing the level of education from primary education to secondary education, or from secondary education to higher education leads to a 4.9% increase in the degree of purchase of health insurance. An important influence comes from the consumption behavior index. One-unit increase in its level causes a 3.5% increase in the degree of use of health insurance. Population’s willingness to purchase insurance products using online platforms has the potential to increase the degree of use of health insurance by 2.6%. In contrast, the preferential use of information sources with a higher degree of credibility can lead to an increase in the degree of use of health insurance by 0.8%. The only variable with a negative influence is age. One-unit increase in age group leads to a 7.2% reduction in health insurance utilization.

In order to highlight the changes in the intensity of the influence of different factors during the COVID-19 pandemic, a multiple linear regression model is proposed for the analysis of the use of health insurance in the last 3 years (UT_3Y). It includes 6 variables, of which 3 behavioral variables and 3 socio -demographic variables, but different compared to those used in the previous regression model, resulting from the correlation analysis. The general form of the regression model is:

$$UT_3Y = \beta_0 + \beta_1 x ISI + \beta_2 x MAB + \beta_3 x MOD_A + \beta_4 x Age + \beta_5 x Education + \beta_6 x Income$$

To validate this model and determine its parameters, we used the SPSS software program, obtaining the following results:

Table 10. Model Summary 2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.293 ^a	.086	.071	.48094	.086	5,817	6	372	.000	1,942

a. Predictors: (Constant), Income, MAB, ISI, MOD_A, Age, Education

b. Dependent Variable: UT_3Y

Source : Processing with the help of SPSS

Table 11. ANOVA – model 2

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	8,073	6	1,345	5,817	.000 ^b
Residual	86,043	372	.231		
Total	94,116	378			

a. Dependent Variable: UT_3Y

b. Predictors: (Constant), Income , MAB, ISI, MOD_A, Age, Education

Source: Processing with the help of SPSS

The coefficient of determination (R2) for this model increased to 0.086, which means that the variables included in the model explain 8.6% of the decision to purchase health insurance during the pandemic. The obtained model is statistically valid, the Sig indicator being equal to 0, lower than the significance threshold of 0.05.

Parameters of the regression model for the analysis of the use of health insurance during the COVID-19 pandemic (UT_3Y) are presented in Table 12.

Table 12. Coefficients – model 2

Model	Unstandardized Coefficients	Standardized Coefficients		t	Sig.	Correlations			Collinearity Statistics		
		B	Std. Error			Beta	Zero-order	Partial	Parthian	Tolerance	VIV
		1	(Constant)			.196	.176				
	ISI	.014	.008	.086	1,639	.102	.154	.085	.081	.898	1,113
	MAB	.053	.018	.148	2,952	.003	.178	.151	.146	.972	1,029
	MOD_A	.069	.052	.067	1,319	.188	.124	.068	.065	.948	1,055
	Age	-.057	.028	-.106	-2,058	.040	-.165	-.106	-.102	.925	1,081
	Education	.053	.043	.065	1,228	.220	.133	.064	.061	.887	1,127
	Income	.033	.020	.084	1,636	.103	.138	.085	.081	.923	1,083

a. Dependent Variable: UT_3Y
 Source: Processing with the help of SPSS

Durbin -Watson test was applied also for this model. The result of 1.942 (Table 8) , close to 2, signifies that there is no autocorrelation of errors for the proposed model.

The hypothesis of multicollinearity was tested using the VIF indicator. Values of this indicator lower than 5 for all variables included in the model concluded that there is no multicollinearity between the variables in the model.

Under these conditions, the multiple linear regression model is validated, with the following form:

$$UT_{3Y} = 0.196 + 0.014 x ISI + 0.053 x MAB + 0.069 x MOD_A - 0.057 x Age + 0.053 x Education + 0.033 x Income$$

This model confirms the direct correlation between the use of health insurance over the last 3 years and the index of information sources, the motive for choosing the insurer, the method of purchasing the insurance, the level of education and income, respectively an inverse correlation with age.

We found that, during the COVID-19 pandemic, the greatest influence on the decision to purchase health insurance was the method of purchase. The online purchase option has significantly increased its influence compared to the pre-pandemic period, generating a potential increase in the degree of use of health insurance by 6.9%. Also, the reason for choosing the insurer has become a relevant factor, unlike the situation before the pandemic. Elements such as "level of coverage" have become much more important in the decision to purchase health insurance than "recommendation of a friend". One-unit increase in the score related to the reason for choosing the insurer caused a 5.3% increase in the degree of use of health insurance.

The importance of the index of information sources has also increased. Thus, the preferential use of information sources with a higher degree of credibility lead to an increase in the degree of use of health insurance by 1.4%, a value higher than that of the period before the pandemic (0.8%). Changing the level of education from primary education to secondary education, or from secondary education to higher education led to a 5.3% increase in the degree of use of health insurance.

Consumption behavior, which was an important influencing factor in the period before the COVID-19 pandemic, no longer exerted a relevant influence in the last 3 years.

Age remained the only variable with a negative influence on the purchase of health insurance, even in the analysis of the last 3 years. The increase by one unit of the age group led to the reduction of the degree of use of health insurance over the last 3 years by 5.3%, a value lower than that related to the pre-pandemic period.

Important changes are thus highlighted in the factors that influenced the decision to purchase health insurance during the COVID-19 pandemic compared to the previous period. The influence degree was modified - new determinant factors were recorded (the motive for choosing the insurer),

other factors increased their influence (the method of purchasing the insurance and the index of information sources), and other factors reduced the intensity of their influence, becoming irrelevant (the consumption behavior index).

4. Discussion

The results of the research led to the validation of some previously formulated research hypotheses and the invalidation of others, as follows:

- Hypothesis H1 - " People with appropriate consumption behavior tend to take out private health insurance " was validated for the entire analyzed period, but was invalidated during the COVID-19 pandemic, which leads us to the conclusion of the partial validation of this hypothesis;
- Hypothesis H2 – " The source of information directly influences the decision to purchase insurance " was validated in both scenarios;
- Hypothesis H3 - " People willing to save prefer to take out insurance " was invalidated in both scenarios;
- Hypothesis H4 - " Benefits of insurance products determine the purchase decision " was validated only for the period of the COVID-19 pandemic, being invalidated for the entire period, which leads us to the conclusion of the partial validation of this hypothesis;
- Hypothesis H5 - " The use of digital solutions in insurance leads to an increase in access to health insurance " was validated in both scenarios.

We found that out of the 5 research hypotheses formulated, based on the research carried out, 2 hypotheses were fully validated, 2 hypotheses were partially validated, and one hypothesis was invalidated.

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

In this paper we analyzed the main factors determinant for the purchase of private health insurance, based on evidence of a Romanian study. In insurance underwriting, the consumption behavior and the financial behavior of the consumers may be of utmost importance in assessing the probability of contracting a new policy as well as the range of coverages offered by the product.

We undertook testing five hypothesis that would be useful for future actuarial computations and product developments. As in other studies, the results do not support a positive correlation all the time among the variables studies giving documentation to advantageous selection and not adverse selection. As expected, the abrupt development of digital solutions created by the COVID19 pandemic encouraged the purchase of private insurance – as flexibility of the online stressed out the benefits of time and client relationship management that otherwise would not have been observed. Moreover, due to the pandemic, the trust in the official sources of information became one evident factor taken into consideration when deciding to contract a private health insurance as fake news and unreliable medical explanations invaded our lives and generated confusion.

Age, income, and level of studies offer a positive correlation with the decision to buy a private health insurance – a conclusion reached also by other studies on national markets. Cognitive ability determines the healthier consumers to purchase private insurance for reasons of convenience or benefits offered by private hospitals and therefore outnumber those with poorer health conditions that access private insurance only in case of fragile health status.

Our results offer insights into the factors important in the purchase decision of individuals, as private insurance complements the public health sector. Despite the low level of costs in the public system, consumers may be more attentive to private solutions of health care as long waiting lists or limited access to basic medical services may reduce the openness to national system.

Author Contributions: Conceptualization, Marian Siminică, Laura Naghi and Cătălin Câmpeanu; Data curation, Marian Siminică; Formal analysis, Marian Siminică; Funding acquisition, Marian Siminică and Cătălin Câmpeanu; Investigation, Cătălin Câmpeanu; Methodology, Marian Siminică and Laura Naghi; Project administration, Marian Siminică; Resources, Marian Siminică, Laura Naghi and Cătălin Câmpeanu; Software, Marian Siminică; Supervision, Marian Siminică; Validation, Marian Siminică, Laura Naghi and Cătălin Câmpeanu; Visualization, Laura Naghi and Cătălin Câmpeanu; Writing – original draft, Marian Siminică, Laura Naghi and Cătălin Câmpeanu; Writing – review & editing, Marian Siminică, Laura Naghi and Cătălin Câmpeanu.

Funding: This research received no external funding.

Data Availability Statement: For access to data supporting results please contact to the authors of the article.

Conflicts of Interest: The authors declare no conflict of interest.

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Investigating the Effectiveness of Electric Vehicle Technologies Training and Its Impact on Workforce Excellence with an Empirical Study

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Abstract: This study investigates how EV technology-related training influences knowledge and operational performance amongst employees of a manufacturing firm in Türkiye. In this respect, the effects of training intervention were measured across various departments such as R&D, Sales, and Operations through a pre-test–post-test experimental model. In this regard, statistical analysis showed that overall, there was a significant improvement in knowledge levels after training, though with higher increases in knowledge gains from the R&D and Sales departments. The correlation tests showed a positive relation of better knowledge with better operational outcome, but again, the study shows that influence from external factors such as resource availability and workplace dynamics may also lead to certain variations in this outcome. Our findings strongly indicate how specially designed departmental training can better satisfy peculiar needs, which are necessary for such fast-growing industries as EV manufacturing. In addition, aligning the content of training with roles and responsibilities will optimize returns on investment for organizations and make them competitive in environments where technological changes are an important issue.

Keywords: Electric Vehicle Training, Operational Performance Improvement, Knowledge Management in EV Manufacturing, Customized Employee Development, Workforce Excellence in High-Tech Industries

Citation: Gültaş, M. P.; Özel, E.; Darendeoğlu, O.; Çadirci, P.; Ürel, Z.; Dikmen, İ. C. & Karadağ, T. (2025) Investigating the Effectiveness of Electric Vehicle Technologies Training and Its Impact on Workforce Excellence with an Empirical Study. *Journal of Economics and Business Issues*, 5(2), 35-43.

Received: 13/05/2025

Accepted: 20/07/2025

Published: 31/07/2025

1. Introduction

Transportation is an essential component of modern life. However, conventional internal combustion engines are highly polluting, and as environmental concerns continue to grow worldwide, public interest in these traditional vehicles has steadily declined. Fully electric vehicles, which produce zero exhaust emissions, represent a far more environmentally friendly alternative. As a result, electric vehicles have sparked a revolution in the transportation industry, with their numbers increasing day by day. In addition to their low operating costs—made possible by batteries instead of fossil fuels—electric vehicles have fewer and more stable components compared to internal combustion engine vehicles, which lowers maintenance expenses [1]. Furthermore, numerous governments offer special incentives, such as tax breaks and subsidies, to encourage electric vehicle ownership [2].

Because electric vehicle technologies align with global sustainability goals, the number of organizations investing in this field is growing [3]. Nonetheless, human resources traditionally trained in conventional manufacturing technologies may sometimes fall short in meeting the emerging demands of this new industry. Consequently, intensive training programs have been introduced to enhance the expertise of workers specializing in electric vehicle technologies [4].

Despite the increasing attention on these training programs—particularly those focusing on employees' knowledge levels—their impact on operational performance remains insufficiently discussed in the literature. To address this gap, the present study examines how electric vehicle–focused training influences employees' knowledge and reflects on operational performance. For this purpose, a variety of training programs were developed for multiple departments, including R&D, Sales, and Operations, at a Turkish factory that manufactures electric vehicles. Changes in employees' knowledge levels before and after the training were evaluated, and the effects of these knowledge levels on different departments within the organization were also assessed.

Given the importance of this topic for achieving operational excellence, the study emphasizes the effects of organizational training on employee performance and operational efficiency. Previous research has explored employee performance and productivity, revealing that intensive corporate training programs can significantly increase employee motivation and product quality [5]. Nevertheless, there remains a need to enrich the literature on how specialized training in technologically focused fields—such as electric vehicles—affects production and operational performance [6]. Against this backdrop, the current study offers insights that are valuable both academically and industrially, contributing a new perspective to the existing body of knowledge.

2. Theoretical Background

The level of employee knowledge related to their jobs, along with their motivation, is strategic elements that increase productivity in businesses and, consequently, enhance competitiveness [7]. In this regard, employee trainings and motivation programs have become more widespread, and businesses' appreciation of such improvements—aimed at boosting long-term operational efficiency—has grown over time. Through these measures, they strive to move together as a unified whole to achieve long-term objectives more effectively. In recent years, numerous studies have been published on the impact of employee training and motivation [8, 9, 10, 11]. This is because the significance of training for operational efficiency has been realized, especially in terms of developing employees' problem-solving skills and their ability to quickly respond to process disruptions. Research in this area shows that training programs must consider employees' current knowledge levels and the specific needs of the business. Acquiring sector-specific knowledge and skills plays a critical role in making operational processes more effective [12].

In 2016, David J. Stanley and John P. Meyer, examined the relationship between employee commitment and job performance through the lens of the three-component commitment model, which includes affective, normative, and continuance commitment [13]. Their study analyzed how this commitment types relate to task performance and citizenship behaviors. The findings showed that affective commitment has the strongest positive correlation with performance, while normative commitment has a weaker but still positive effect. Continuance commitment was found to be either unrelated or weakly negatively related to performance. The authors also highlighted that examining commitment components individually can be misleading, as different commitment profiles have complex relationships with performance outcomes. They recommended that future research focus on clarifying causal links between commitment and performance and exploring the role of cultural factors in this relationship. For example, Khan (2012) highlights that training programs raise employees' motivation levels and intensify their contributions toward process improvement.

Recently, the number of studies in this field has increased considerably. Particularly, digital training tools and virtual reality–based trainings, developed mostly after the pandemic, have been observed to speed up employees' learning pace and increase their interest in new information [14]. It has been found that virtual simulation–based trainings contribute significantly to enhancing employees' practical skills, thereby reducing errors in business operations. Moreover, the long-term impacts of digital training and distance learning tools on companies have also been examined [15]. Because these programs are flexible, employees can learn at their own pace, increasing their knowledge levels and more effectively integrating this knowledge into operational processes [16].

For emerging fields such as electric vehicle technologies, employee training processes are critical for supporting adaptation. Fechtner et al. [6] notes that training in new-generation vehicle technologies fosters a notable improvement in employees' knowledge levels and in their familiarity with the technologies. These trainings are especially beneficial for R&D and technology development staff, boosting both their productivity and their capacity for innovation in operational stages [17].

Using innovative training methods to understand the intricate technical structures of electric vehicles has been shown to produce recognizable enhancements in operational performance [4]. Once innovative training practices become embedded in organizational culture, businesses can attain the status of “learning organizations.” Rebelo & Gomes (2011), in a study on learning organizations and employee performance between 2006 and 2015, reveals how learning organizations transform traditional definitions of work performance [18]. Another study focusing on Korean labor institutions investigated the structural impact of organizational culture as a learning tool on self-

efficacy and job involvement. This culture's role in elevating employee performance is highlighted. Learning organizations establish a framework that promotes knowledge sharing and teamwork among employees, establishing a vital environment for process enhancement and innovation.

Sivakumar & Kumar (2019) assert that incorporating knowledge management into organizational processes accelerates employees' adaptation to newly emerging technologies, thereby having a positive effect on overall operational performance [19]. Particularly in recent years, with the rise of digital transformation and Industry 4.0, knowledge management practices have gone through significant changes [6]. By leveraging digital tools, information access and integration into work processes become simpler, which is directly reflected in the operational performance of employees. Khan (2012) underlines that knowledge management systems increase employees' contributions to work processes and speed up their adoption of cutting-edge technologies [11].

In addition, using knowledge management processes aligned with Industry 4.0 in learning organizations offers substantial potential for improving operational effectiveness [15]. In electric vehicle production, implementing these new technologies—together with training programs that raise employees' knowledge level enables better transparency and traceability in manufacturing stages, which improves the efficiency of quality control mechanisms [16].

Several works in the literature frequently highlight how training in high-tech industries facilitates the growth of employees' innovative thinking and problem-solving capabilities. In this respect, Wang et al. (2025) contend that education on digital technologies heightens employees' ability to apply pioneering methods in their everyday tasks, yielding advantages in overall productivity [20]. In the context of electric vehicle technologies, such training has been shown to enhance employees' creative input in manufacturing processes [6].

Organizations often measure the return on investment (ROI) of training as a key metric for evaluating the financial payoff of these initiatives. Multiple studies in literature have explored how training influences operational outcomes. Wang et al. (2013) likewise propose that over time, training programs significantly raise manufacturing efficiency and produce positive financial benefits for firms [17].

Rivaldo and Nabella conducted a study analyzing four major factors that shape employee performance: training, experience, and discipline. Their survey of 87 workers used multiple regression analysis to gauge how these factors affect performance. The results indicate that training, training programs, experience, and discipline each have a favorable impact on employee performance, providing beneficial insights for administrative approaches [21].

Chen et al. investigated the effect of organizational support on employee performance within contexts of flexible production. Employing social change theory and organizational support theory, their research examined the mediating role of employee attitudes between organizational support and employee performance, as well as the moderating role of organizational justice. Surveying 180 participants from seven significant automotive manufacturing facilities in China, they tested their assumptions using multiple linear regression analysis. The results revealed four fresh indicators of frontline worker performance in flexible manufacturing: continuous learning, teamwork, problem-solving, and proactive working. They categorized organizational support as either reinforcing or inhibitory. While reinforcing support has a strong beneficial impact on employees' new performance, an effect strongly mediated by their sense of belonging—inhibitory support was more related to employees' sense of respect. However, this sense of respect did not alter the new performance. Additionally, organizational justice significantly moderates the correlation between organizational support and employee attitude [22].

These positive influences of training programs on operational efficiency demonstrate why it is essential for organizations to expand their training budgets. In technology-driven sectors like electric vehicles, training not only elevates knowledge but also encourages the assimilation of innovations into operational workflows [6].

In this section, different aspects of how employee training supports operational performance have been examined. Notably, in forward-looking industries like electric vehicle technologies, knowledge management and training procedures play a key role in helping businesses sustain their competitive edge. Recent studies underscore that training and knowledge management are central to enhancing the effectiveness of operational processes, reinforcing the notion that such initiatives should be approached as strategic investments. To guide this empirical investigation, the study was structured around the following key assumptions. It was anticipated that training programs focused on electric vehicle (EV) technologies would enhance employees' domain-specific knowledge and, in turn, positively influence operational performance metrics. Based on this rationale, the study hypothesized that (1) employees' knowledge levels would significantly improve following the training, and (2) this improvement would translate into enhanced operational effectiveness, with possible variations across different departments. These hypotheses provided the foundation for the subsequent methodological design.

3. Methodology

3.1. Research Design

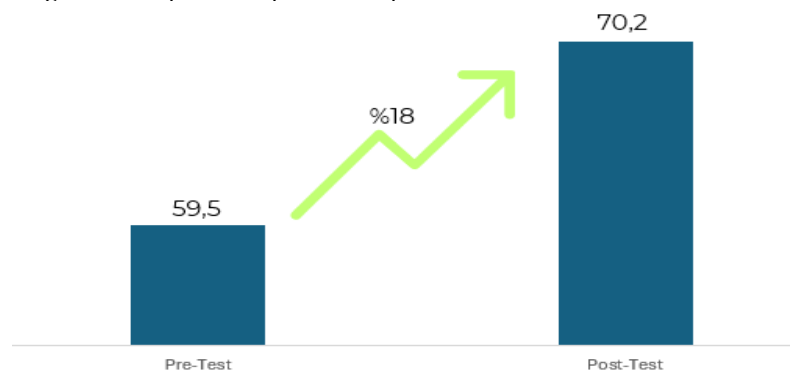
This study adopted a quasi-experimental quantitative research design, focusing on evaluating the impact of electric vehicle (EV) training on employees' knowledge levels and operational performance. As Creswell (2014) defines, quantitative research involves systematic empirical investigation using statistical, mathematical, or computational techniques [23]. A pre-test/post-test model without a control group was employed, which is widely used in training evaluation research [24]. This design enables the measurement of within-subject changes over time and is particularly suitable when evaluating intervention-based learning environments without access to a control group [25, 26]. This study employed a quantitative research design to evaluate the influence of trainings on electric vehicle (EV) technologies on employees' knowledge levels and practical performance at a Turkish firm that manufactures EVs. Training effectiveness was determined by comparing participants' pre-training (pre-test) and post-training (post-test) results. For this reason, a causal-comparative research approach based on a pre-test–post-test model was utilized. Additionally, descriptive analyses were carried out to compare differences among various departments. The sample of the study consisted of all employees working in different departments of this EV-manufacturing firm, all of whom underwent training aligned with the company's operational goals. In total, 315 participants took part in the pre-test phase and 314 in the post-test phase (Table 1).

Table 1. Number of participants

Department	Pre-Test	Post-Test
Research and Development	94	94
Strategy and Business Development	4	10
Sales WE	3	0
Sales EMEA	20	8
After Sales Services	41	52
Operations	76	89
Human Resources	38	33
Management Support	10	10
Financial Affairs	29	18
Total	315	314

Before the training, participants' knowledge levels and practical performance were measured with the pre-test. The training program's curriculum covered both theoretical and practical information regarding EV technologies. After the training, the same participants were assessed again through the post-test to measure changes in their knowledge levels and any improvements in their practical performance.

Figure 1. Comparison of pre-test and post-test mean scores



To understand how much the training improved the participants' knowledge levels, average pre-test and post-test scores were analyzed. While the average score in the pre-test was 59.5 (based on a 100-point scale), the average post-test score increased to 70.2. This corresponds to an 18% improvement following the training (Figure 1).

3.2. Data Collection

Data used in this research was obtained from tests administered before and after the EV technology trainings. Employees from various departments—including R&D, Sales, and Operations—participated, and their knowledge levels were assessed in both phases. The tests were developed based on the content of the training and aimed to measure changes in knowledge.

Data collection involved surveys and tests, yielding numerical data. Although qualitative insights were collected through short open-ended questions, their use was limited to supporting the interpretation of the quantitative results and did not influence the statistical analyses. The study remained fundamentally quantitative in its design and execution. The compiled data were analyzed using SPSS software.

3.3. Sample

The study employed a maximum variation purposive sampling method to ensure representation across diverse departments such as R&D, Operations, Sales, HR, and more. This method aims to capture a wide range of perspectives and experiences by intentionally selecting participants from different units within the organization [27]. A total of 315 employees participated in the pre-test phase, while 314 completed the post-test.

This approach was deemed suitable for this study as it enabled the researchers to assess how training impacts may differ across functional roles with varying responsibilities and knowledge bases.

3.4. Analysis

Initially, descriptive statistics were used to examine the collected data. These analyses provided demographic details about the participants and indicated the mean scores from their pre- and post-training evaluations. A paired-sample t-test was performed to test the effectiveness of the training, which examined if the difference between employees' pre- and post-training knowledge scores was statistically meaningful. Paired-sample t-tests are commonly applied to assess pre- and post-intervention knowledge changes within the same subjects, particularly in organizational learning studies [25].

Table 2. Paired sample t-test results

Metric	Value
t-statistic	2.35
p-value	0.019

The results show a significant difference ($p < 0.05$) between participants' pre-test and post-test scores. Based on these findings, it can be inferred that the training effectively boosted employees' knowledge levels. To see how different departments were impacted by the training, a variance analysis (ANOVA) was conducted. ANOVA was selected to detect whether mean differences in knowledge improvement exist across departments—a technique frequently used when comparing group-level intervention effects [28].

Table 3. ANOVA Results for Improvement by Department

No		sum_sq	df	F	PR (>F)
1	Department	13555.62	49.0	1.85	0.055
2	Residual	4481.64	30.0		

The ANOVA results yielded a marginally non-significant result regarding differences among departments ($F = 1.85$, $p = 0.055$). While this value slightly exceeds the conventional threshold of 0.05, it suggests a possible trend toward significance. This result may indicate that departmental differences in knowledge gains exist, although they were not statistically confirmed at the 5% level.

A correlation analysis was also carried out to investigate the relationship between knowledge gains and operational performance. It revealed a positive and significant association ($r = 0.45$, $p < 0.01$), suggesting that increases in knowledge levels directly contribute to improved operational processes, thereby enhancing overall productivity within organizations.

Furthermore, a regression analysis was undertaken to model the influence of post-training knowledge levels on operational performance. This analysis incorporated both pre-test scores and

departmental variables. Although the model's explanatory power was modest ($R^2 = 0.243$), the findings indicated that the effect of training varied across departments.

Moreover, a regression analysis was undertaken to model the effect of post-training knowledge gains on operational performance. This analysis evaluated the influence of pre-test scores and departmental variables on the post-test scores. Although the model's explanatory power was limited ($R\text{-squared} = 0.243$), the results showed that the effect of training varied among departments:

Table 4. OLS regression results

R-squared	F-statistic	Prob (F-statistic)
0.243	0.3726	0.993

3.5. Department-Based Analysis

The interdepartmental analyses suggested that training effectiveness differed across departments. Departments like R&D and Sales experienced higher knowledge-level improvements compared to others, presumably because these roles require more technical expertise. The Operations department, on the other hand, exhibited a more limited knowledge gain. These findings imply that training content should be customized to each department's specific operational needs.

3.6. Validity & Reliability

Various measures were taken to assure the validity and reliability of this research. Experts in EV technologies reviewed the tests to confirm content validity. Additionally, Cronbach's alpha was computed to check the consistency of the tests, and because the alpha value exceeded 0.70, reliability was deemed acceptable [29].

3.7. Ethical Considerations

Participants took part voluntarily, were all over 18, and fully understood the significance of the study. Each participant was briefed on the objectives of the research and informed about how the data would be used, after which they provided consent. Their identities remain confidential, and the data is used strictly for academic purposes. Ethical approval for the study was obtained from Malatya Turgut Ozal University, Social Sciences Ethics Committee. All participants were over 18, participated voluntarily, and were informed about the purpose, confidentiality, and data use in accordance with academic ethical standards. The methods discussed in this section offer a systematic framework for achieving the research objectives and for meaningfully assessing how training influences operational performance.

4. Discussion

The results of this study demonstrate that training programs focused on electric vehicle (EV) technologies significantly enhance employees' knowledge levels, as evidenced by the increase in post-test scores. This finding aligns with earlier research asserting that domain-specific training leads to measurable improvements in knowledge acquisition and job performance [30]. It confirms that customized technical training, when aligned with evolving industry needs, serves as a crucial strategic investment for companies operating in high-tech manufacturing.

Furthermore, the observed positive and significant correlation between knowledge gains and operational performance ($r = 0.45$, $p < 0.01$) reinforces the idea that training does not merely influence cognitive outcomes but also drives tangible improvements in workplace efficiency. Sivakumar & Kumar (2019) highlighted that effective knowledge management, especially when paired with structured training plays a pivotal role in organizational adaptability, particularly in the context of digital transformation [19]. These results also echo the meta-analytical findings of Wang et al. (2025), who noted that training interventions yield long-term benefits for both employee productivity and operational quality [20].

A deeper analysis by the department revealed that R&D and Sales teams benefited more significantly from the training than the Operations department. This pattern emphasizes that employees in more specialized or knowledge-intensive roles often show greater responsiveness to technical training, especially when it directly relates to their everyday tasks. Our findings support this differentiation, suggesting that department-specific instructional design is vital for maximizing training effectiveness.

Although the ANOVA results did not reach statistical significance at the conventional threshold ($p = 0.055$), the near-significant value indicates a potential trend that may become significant

in studies with larger sample sizes or more targeted training content. (Janega et al., 2004) emphasized the importance of tailoring training content based on departmental knowledge baselines and operational responsibilities. In this study, such differentiation appears to influence knowledge retention, even if not confirmed through strict statistical significance [31]. This finding also aligns with the assertions of Blanchard and Thacker (2023), who advocate for modular and role-adaptive training designs in complex organizational settings [24].

In addition, open-ended feedback from participants suggests a demand for more interactive and practical training formats, especially among operational teams. While not part of a formal mixed-methods approach, these qualitative insights provide supporting context to the quantitative results and indicate avenues for future training refinement. Similar conclusions were reached by Tomovic et al. (2024), who found that hybrid training models—combining digital and hands-on learning—boost knowledge transfer, particularly in industrial environments undergoing technological transition [32].

In conclusion, this study contributes to the growing body of literature on workforce development in EV manufacturing by illustrating that training effectiveness varies significantly across departments. The findings highlight the need for a nuanced, department-sensitive approach to training design—one that balances conceptual knowledge with practical application. Future studies could expand on this foundation by exploring blended learning models and longitudinal effects of repeated training interventions across departments.

5. Conclusions

The conclusions reached through this investigation go beyond the mere observation that employee training improves operational performance. By adopting a nuanced perspective, we discovered that not all departments respond identically to the same training content. R&D and Sales teams, for instance, seem naturally predisposed to benefit more—possibly because their roles already demand a higher level of technical or customer-focused expertise. Meanwhile, the Operations department witnessed more modest gains, suggesting that a theory-heavy curriculum may not suffice for roles that rely on hands-on, practical skills.

Our work thus underscores the originality of a more granular approach to organizational training. Rather than assuming a uniform strategy, it points to the importance of designing specialized modules that speak directly to each department's unique realities. This strategy not only facilitates deeper learning but also helps embed newly acquired knowledge into the daily workflows, thereby producing more tangible operational results. Another dimension worth noting is that, while the statistical analyses confirm a positive relationship between knowledge gains and performance, the influence of non-training factors remains significant ranging from management support to the very culture of innovation within the firm.

In essence, this study offers both empirical evidence and a conceptual framework for approaching training in technology-intensive industries. It does not simply call for more training; rather, it calls for better, more thoughtful training, meticulously adapted to distinct departmental contexts. Future research could build upon these insights by exploring how digital learning tools and continuous education might further refine knowledge transfer, especially in high-tech fields where rapid updates are the norm. By shedding light on the interplay between specialized training, department-level needs, and organizational performance, we hope to inspire other scholars to investigate deeper into these dynamics, fostering a richer understanding of how companies can thrive in technologically advanced markets.

Nevertheless, this study is not without limitations. First, quasi-experimental design without a control group limits the ability to isolate training effects from other external influences, such as concurrent organizational changes or managerial interventions. Second, the relatively short timeframe between the pre-test and post-test may not fully capture the long-term impact of training on operational performance. Third, while the study focused on knowledge gain and self-reported operational improvement, it did not incorporate direct observational or productivity-based performance metrics, which could strengthen the findings. Lastly, the study was conducted within a single EV manufacturing firm in Türkiye, which may limit the generalizability of the results to other sectors or cultural contexts. Future research may address these limitations by employing longitudinal designs, incorporating control groups, and including more objective performance measures across diverse organizational settings.

6. Patents

This research did not result in any patents.

Supplementary Materials: The following are available online at www.jebi-academic.org/xxx/s1, Figure S1: title, Table S1: title, Video S1: title.

Author Contributions: Conceptualization, M.P.G. and I.C.D.; methodology, M.P.G.; software, M.P.G.; validation, M.P.G., I.C.D., and T.K.; formal analysis, M.P.G.; investigation, M.P.G.; resources, M.P.G.; data curation, M.P.G.; writing—original draft preparation, M.P.G. I.C.D.; writing—review and editing, M.P.G., T.K., I.C.D.; visualization, M.P.G.; supervision, I.C.D.; project administration, E.Ö.; training program development and implementation, E.Ö., O.D., P.Ç., Z.Ü.; funding acquisition, none. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgments: The authors gratefully acknowledge the support of the Human Resources Department at TEMSA Skoda Sabancı Transportation Vehicles Inc. for coordinating training logistics and facilitating access to participants. Special thanks to the data entry and teams for their assistance in pre-test and post-test administration.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A

- Appendix A1. Sample Questions from the EV Knowledge Assessment
- Appendix A2. Overview of EV Training Curriculum by Department
- Appendix A3. Cronbach's Alpha Reliability Statistics by Department.

Appendix B

- Figure A1. Change in Average Knowledge Scores across Departments
- Table A1. Participant Demographics by Department and Seniority
- Figure A2. Correlation Plot: Knowledge Gain vs. Performance Self-Report.

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Analyzing the Relationship between Balance of Trade and Unemployment in the South African Economy

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Abstract: This study examines the relationship between the Balance of Trade (BOT) and unemployment in South Africa from 2002 to 2022 aiming to assess whether the BOT positively or negatively affects employment. The increasing openness of trade in a global context and discussions surrounding free and open international trade have sparked numerous studies and debates in recent years. Current trends suggest that governments engage in trade agreements to foster international relationships, often underestimating their potential negative effects on domestic economies. This study aims to investigate and analyze the impact of the balance of trade on employment within the South African economy. Utilizing time-series data from the first quarter of 2002 to the fourth quarter of 2022, the research examines the relationship through unit root tests, stationary tests, multiple-breakpoint tests, an ARDL model, ECM, and residual and stability diagnostic tests using EViews software. The findings quantitatively confirm a significant direct linear relationship between BOT and unemployment in South Africa. Consequently, to enhance employment opportunities, stakeholders in both the private and public sectors must tackle the challenges associated with trade and unemployment, with the study offering several recommendations to revitalize the country's economic prospects.

Keywords: keyword 1; Balance of Trade, Employment, Absolute Advantage, South Africa

1. Introduction

The theory of absolute advantage posits that a nation should specialize in producing goods or services in which it holds an absolute advantage while importing those in which it has an absolute disadvantage. However, despite increases in both exports and imports over recent years, South Africa has witnessed a troubling rise in unemployment (3, 1). As reported by the World Economic (4), a thriving economy typically leads to improved living standards, underscoring the crucial role that employment plays in this pursuit. In the first quarter of 2022, South Africa recorded an alarming unemployment rate of 35.3 percent, the highest globally (16). This crisis highlights the urgent need to investigate the factors contributing to such high unemployment, particularly the nation's heavy dependence on imported consumer goods, which hampers growth across various sectors and reduces local job opportunities (1).

The ongoing global discussions regarding trade openness have prompted numerous studies showcasing its potential economic benefits. Literature indicates that international trade can enhance economic growth through economies of scale, foreign knowledge access, market expansion, and increased competition. In January 2024, the South African Revenue Service (SARS) reported a trade deficit of R9.4 billion, with imports outstripping exports (2); imports rose by 2.5 percent while exports fell by 12.8 percent month-on-month. Trade deficits can adversely impact a nation's gross domestic product (GDP), inflate unemployment rates, escalate exchange rates, and contribute to higher inflation and interest rates. Given the recent surge in unemployment, which reached 32.1 percent in the fourth quarter of 2023 (4) and youth unemployment hitting 44.3 percent, understanding these underlying causes is more critical than ever. This study aims to explore the influence of South Africa's BOT on employment, addressing the under-researched impacts of rising imports, and enhancing the broader understanding of the country's economic dynamics.

Citation: Rhyn, G. F. & Muzekenyi, M. (2025) Analyzing the Relationship between Balance of Trade and Unemployment in the South African Economy, *Journal of Economics and Business Issues*, 5(2), 44-53.

Received: 12/03/2025

Accepted: 25/07/2025

Published: 31/07/2025

2. Literature Review

The BOT plays a critical role in shaping the economic landscape of nations, influencing employment levels and overall economic health. Understanding the dynamics between trade policies, imports, and local job opportunities is essential for addressing high unemployment rates, particularly in vulnerable economies like South Africa. This literature review examines the existing research on BOT and its impact on employment, highlighting gaps in knowledge and the need for further exploration in this vital area. The first section covers theoretical followed by empirical underpinnings.

2.1. Theoretical Framework

The foundation of modern international trade theory originates from Adam Smith, who introduced the concept of absolute advantage in his influential work published in 1776. This theory contradicts the mercantilist perspective, which argued that a nation's wealth and power were dependent on maintaining a trade surplus by maximizing exports and minimizing imports (Maglio, 2024). Instead, Smith championed the idea of free trade, suggesting that countries should specialize in producing goods and services where they possess a relative advantage while importing those that others can produce more efficiently. This shift in perspective highlighted the significance of maximizing profit over mere trade volume, resonating with industrialists and policymakers. Smith's theory posits that, similar to individuals, countries have unique talents and resource endowments that shape their productivity strengths (5). By concentrating on sectors where they hold an absolute advantage, nations can boost their overall economic output and efficiency, leading to mutual benefits from trade. Trade's advantages manifest as firms gain access to larger markets, producing economies of scale and stimulating entrepreneurial innovation. However, while Smith's theory presents a hopeful outlook on trade's role in driving economic growth and employment, it acknowledges potential drawbacks, such as the risk of relying excessively on imports, which can jeopardize domestic industries and cause job losses, particularly in sectors unable to compete with cheaper foreign products (6). Therefore, grasping the implications of the Balance of Trade (BOT) is essential, as it significantly influences economic growth and employment levels. Smith's insights provide relevant context for this study, underscoring the necessity of investigating the relationship between BOT and employment dynamics, which is elaborated on in the following sections.

2.2. Gross Domestic Product

Gross Domestic Product is a fundamental measure of national economic performance and is defined as the total monetary value of final goods and services produced within a country's borders during a specified time (6). The growth or decline in GDP serves as a critical indicator of a nation's economic health and prosperity. In South Africa, GDP is analyzed across ten distinct sectors, which include agriculture, mining, manufacturing, and services, among others (4). Each sector's performance contributes uniquely to the overall economic landscape. Changes in GDP are often employed to assess economic growth, calculated as a percentage change in the value of all final goods and services produced over time (7). A robust GDP growth rate is typically associated with increased employment opportunities, as businesses expand and hire more workers to meet rising demand. Conversely, sluggish GDP growth can precipitate higher unemployment rates, as firms may re-trench employees in response to declining revenue. The relationship between GDP and employment is further complicated by various external and internal factors, including trade policies, economic shocks, and shifts in consumer behavior.

2.3. Balance of Trade

The Balance of Trade represents the monetary value difference between a country's exports and imports over a specified period and serves as a critical measure of a nation's trade performance (8). A positive balance, or trade surplus, indicates that a country exports more than it imports, which is generally viewed as favorable for economic health. Conversely, a trade deficit, where imports exceed exports, raises concerns about sustainability and reliance on foreign goods. The theoretical perspective suggests that a trade surplus can foster economic growth by enhancing foreign currency inflows, enabling investment in domestic industries (8). In contrast, persistent trade deficits can undermine local production capacity, erode job opportunities, and lead to economic vulnerabilities, such as reduced foreign exchange reserves. Thus, understanding the dynamics of BOT is crucial for policymakers aiming to stimulate economic growth and manage employment levels effectively. A country's BOT intricately interacts with its GDP, shaping economic outcomes and influencing public policy decisions.

2.4. Unemployment

Unemployment is a significant economic indicator that reflects the health of a country's labor market and is defined as the condition in which individuals actively seek employment but cannot find work (Hayes, 2024). It is not merely a reflection of job availability but also an essential measure of economic performance. Unemployment is classified into various categories: frictional, cyclical, structural, and institutional. Each type of unemployment arises from different causes and has varying implications for the economy. Frictional unemployment, for instance, is short-term and occurs when individuals voluntarily leave their jobs to seek other opportunities. In contrast, cyclical unemployment links directly to the economic cycle, rising during downturns and declining in periods of growth. Structural unemployment occurs due to technological changes or shifts in industry demand, leading to a mismatch between workers' skills and available jobs. Institutional unemployment arises from government policies and labor market regulations that can create barriers to employment. Analyzing unemployment trends provides crucial insights into economic health and the effectiveness of policies aimed at boosting employment.

2.6. Relationship Between GDP and BOT

In examining the interplay between GDP and the balance of trade, various studies have demonstrated differing perspectives and outcomes across different economic contexts. (10) conducted a comprehensive study on 28 European Union countries, revealing a positive relationship between the trade balance and economic growth. This study, analyzing data from 1998 to 2018, highlighted how a deteriorating trade balance negatively impacted the economic growth of these countries. The research concluded that international trade fosters economic growth by enhancing capital formation, transforming industrial structures, and improving both technological and institutional advancements (10). The findings further emphasize that sustainable economic growth hinges on revenues generated from exports to finance, increasing imports, reinforcing the necessity for a balanced trade approach.

(11) focused their research on the Sri Lankan economy, examining the determinants of BOT. The study underscored the significant role that GDP, import volumes, and inflation rates play in shaping the trade balance, whereas exchange rates did not appear to exert a notable influence. The authors identified Sri Lanka's reliance on imports, specifically consumer goods compromising local production capabilities and, consequently, economic growth. The research also indicated that policies aimed at reducing dependency on imports through market liberalization and domestic production strengthening were essential for improving the trade balance and fostering economic growth.

(12) explored the trade policies of the United States and their impact on BOT and GDP growth, particularly considering the North American Free Trade Agreement (NAFTA). The study found a negative correlation between a rising trade balance and GDP growth, suggesting that increased trade deficits negatively affected economic performance. Coupet's findings emphasize the importance of strategic trade policies in managing the balance of trade to foster economic growth, recommending a closer examination of future agreements to ensure they align with domestic economic goals.

2.7. Relationship Between GDP and Unemployment

The interplay between GDP growth and unemployment has been extensively studied, revealing complex dynamics. (4) investigated the impact of the manufacturing sector on GDP and employment rates in South Africa. The study found that while the manufacturing industry traditionally serves as a significant contributor to economic growth and job creation, its performance has waned over the last two decades. Citing factors such as high import duties, power supply issues, and political instability, Mc Camel concluded that bolstering the manufacturing sector could revitalize both GDP growth and employment rates. Recommendations included enhancing trade laws to protect domestic industries and investing in renewable energy to ensure stable electricity supply.

On a broader scale, (13) analyzed the relationship between entrepreneurship, income, and unemployment in South Africa. Their findings suggested that while the country experiences high per capita GDP growth, unemployment persists at alarming levels. The study illuminated how entrepreneurship initiatives are crucial in addressing joblessness. However, it also noted the obstacles posed by a weak skills base, inefficient regulations, and high transaction costs, urging policy reforms to facilitate an environment conducive to entrepreneurship and employment growth. Further research by (15) examined the agricultural sector's contribution to GDP and employment, suggesting that agriculture plays a vital role in developing economies. As agricultural productivity improves, it creates a foundation for manufacturing and industrial growth, thereby stimulating job

creation. The study highlighted that while agricultural employment may decline with industrialization, its productivity gains remain fundamental to overall economic health.

2.8. Relationship Between Unemployment and BOT

The relationship between unemployment and the Balance of Trade (BOT) has garnered significant attention in empirical literature, yielding diverse findings. (9) investigated the impact of trade openness on unemployment rates in Kenya, concluding that while trade can improve resource allocation and stimulate economic activity, it often exacerbates unemployment as domestic industries face heightened competition from abroad. This study emphasized the necessity for collaboration between government and industry to equip local job seekers with skills relevant to a rapidly evolving global market.

(2) explored the negative correlation between trade openness and unemployment across various income levels and found that trade frequently results in job losses in particular sectors, thereby contributing to rising unemployment. While trade can create opportunities in certain industries, the overall impact tends to disadvantage vulnerable labor markets, especially in developing countries. In contrast, (6) analyzed China's trade expansion, noting that while the nation created millions of new jobs through its export-maximizing trade policies, traditional sectors like agriculture suffered job losses. Jiang highlighted the importance of balancing trade liberalization with policies aimed at protecting and transitioning affected workers into new opportunities. Additionally, (17) focused on the European context, revealing that increased imports from China negatively impacted unemployment in the EU's manufacturing sector, as domestic firms reduced their workforce in response to foreign competition. These findings underscore the complex interactions between GDP, BOT, and unemployment, illustrating that while trade can drive economic growth, its effects on employment can be detrimental, particularly for vulnerable sectors. The subsequent section will outline the methodology employed in this study.

3. Materials and Methods

This study analyzes the link between trade and employment and its impact on the South African economy, focusing on BOT and the unemployment rate. It aims to collect and assess data to identify the causal relationship between these factors. The study employs a defined set of variables to assess the effect of the balance of trade on unemployment. Table 1.1 presents all the variables utilized in the study, accompanied by an explanation of the dependent and independent variables.

Table 1. Variables Specification

Denotations	Variable Specifications
EG	Economic growth (GDP growth rate)
BOT	Balance of trade (export-imports relationship)
UNEMP	Unemployment rate (proxy for employment)
FDI	Foreign direct investments
GDPpc	GDP per capita

The study includes four independent variables: BOT (balance of trade), EG (economic growth), FDI (foreign direct investment), and GDP per capita. While the focus is on the relationship between BOT and GDP concerning unemployment (UNEMP), FDI and GDP per capita are also considered due to their potential short- and long-term impacts on UNEMP. Actual data values were sourced for all variables in the study. The study employs a dynamic model to assess the balance of trade's impact on South Africa's unemployment rate over a specific period, building on Adekunle's (2016) econometric model that examined trade's effect on unemployment across 20 countries. This model allows for testing whether changes in explanatory variables at time lead to immediate changes in the dependent variable at the same time.

The econometric model for analyzing the impact of trade on unemployment, as outlined by (18), is presented below:

$$UNEMP_t = \beta_0 + \beta_1 BOT_t + \beta_2 EG_t + \beta_3 GDPpc_t + \beta_4 FDI_t + \epsilon_t \dots \dots \dots (1)$$

When analyzing time series data, addressing the effects of outliers and calculating elasticity coefficients can be accomplished through logarithmic transformation. Equation 3.3 illustrates the empirical econometric model that will be employed in this study:

$$\text{LnUNEMP}_t = \beta_0 + \beta_1 \text{LnBOT}_t + \beta_2 \text{LnEG}_t + \beta_3 \text{LnGDPpc}_t + \beta_4 \text{LnFDI}_t + \varepsilon_t \dots (2)$$

This study highlights the critical need for using stationary data to prevent spurious results when examining the relationship between the Balance of Trade (BOT) and unemployment. To verify that the data is stationary, several statistical tests will be employed, including the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, along with the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test. The ADF and PP tests evaluate unit roots, while the KPSS test directly assesses stationarity, providing a comprehensive method to confirm the data's statistical properties before further analysis. Additionally, to explore long-term relationships among non-stationary data series, the study applies the Autoregressive Distributed Lag (ARDL) model (19), which can accommodate variables that are stationary in different forms (I(0) or I(1)). The ARDL framework enables the testing of cointegration among the variables and the assessment of both long-run and short-run dynamics. To ensure the reliability and stability of the model's estimates, model diagnostic tests including assessments for residual normality, serial correlation, and heteroscedasticity will be conducted. Furthermore, stability diagnostic tests such as CUSUM and CUSUMSQ will provide additional validation of the persistence of the model parameters over time.

4. Results

4.1. Descriptive Statistics of the Variables

Descriptive statistics summarize the key features of a dataset (9), and the main methods used in this study are outlined in Table 2. The means in the first row show the average values of each variable for the selected period, while the standard deviation in the fourth row indicates variability around the mean. Skewness in the fifth row reveals the shape of variable distributions, with positive skewness indicating a long right tail and negative skewness a long-left tail. Additionally, row six presents kurtosis measurements, which assess the peakedness of distributions, and the seventh and eighth rows display the Jarque-Bera statistics, testing for normal distribution in the dataset.

Table 2. Estimated Descriptive Statistics Results

	UNEMP	BOT	EG	GDPpc	FDI
Mean	0.269	7 130.577	0.006	0.068	18 089.89
Maximum	0.353	52 700	0.137	0.109	562 000
Minimum	0.215	-10 700	-0.17	0.028	-13 900
Std. Dev	0.032	12 728.650	0.025	0.024	61 539.01
Skewness	0.955	1.821	-2.367	-0.021	8.364
Kurtosis	3.369	6.468	37.223	1.767	74.421
Jarque-Bera	13.243	88.503	4 177.685	5.326	18 832.520
Probability	0.001	0	0	0.07	0
Observations	84	84	84	84	84

The study's analysis of variables using the Jarque-Bera test indicates that the UNEMP has a JB statistic of 13.243 and a p-value of 0.001, suggesting non-normality due to skewness (0.955) and kurtosis (3.369). The BOT has a JB statistic of 88.503 and a p-value of 0.000, also indicating strong non-normal distribution with notable skewness (1.821) and high kurtosis (6.468). EG exhibits an exceptional JB statistic of 4,177.685 and a p-value of 0.000, reflecting significant deviations from normality, supported by high kurtosis (37.223) and negative skewness (-2.367). Conversely, GDPpc has a moderate JB statistic of 5.326 and a p-value of 0.070, suggesting it may approximately follow a normal distribution. In contrast, FDI shows a remarkably high JB statistic of 18,832.520 and a p-value of 0.000, indicating strong non-normality with extreme skewness (8.364) and kurtosis (74.421). Overall, UNEMP, BOT, EG, and FDI display significant deviations from normality, while GDPpc may be nearly normal, suggesting that transformations, such as natural logarithms, are necessary to address skewness in further modeling and analyses. The data was also tested for unit root using ADF and the results are presented in the following subsection.

4.2. Unit root and correlation results

A stationary time series exhibits constant serial correlation over time. Unit root tests, correct t-statistics non-parametrically to handle structural breaks and undefined correlations. To minimize variations in the data and accurately assess growth rates, the study transforms the dataset into natural logarithmic (Ln) form. The results are presented in Table 3.

Table 3. Augmented Dickey-Fuller Unit Roots Results

Variables	At Level I(0)		At 1 st Difference I(1)		Results (order of integration)		
	Without trend	With trend	Without trend	With trend			
	T-statistics	P-value	T-statistics	P-value			
LnUNEMP	-1.039	0.736	-1.945	0.622	-13.323	0 **	I(1)
LnBOT	-2.457	0.130	-3.041	0.128	-21.833	0 **	I(1)
LnEG	-10.631	0 **	-----	-----	-----	-----	I(0)
LnGDPpc	-2.835	0.058	-1.308	0.879	-11.295	0 **	I(1)
LnFDI	-8.847	0 **	-----	-----	-----	-----	I(0)

(**) The rejection of the null hypothesis of not stationary at the 1% significance level

(*) The rejection of the null hypothesis of not stationary at the 5% significance level

The ADF unit root test results reveal that some variables are stationary at level while others require differencing to achieve stationarity. For the LnUNEMP, the T-statistic is -1.039 with a p-value of 0.736 at I(0), indicating non-stationarity, but becomes stationary at first difference with a T-statistic of -13.323 and p-value of 0.000 at I(1). Similarly, the LnBOT has a T-statistic of -2.457 and p-value of 0.13 at I(0), also non-stationary, while at I(1), it shows a T-statistic of -21.833 and a p-value of 0.000, confirming stationarity. The LnEG is already stationary at level with a T-statistic of -10.631 and p-value of 0.000. The LnGDPpc shows a T-statistic of -2.835 and p-value of 0.058 at I(0) but becomes stationary at first difference with a T-statistic of -11.295 and p-value of 0.000 at I(1). The LnFDI is stationary at level with a T-statistic of -8.847 and a p-value of 0.000. Consequently, since each variable has shown either I(0) or I(1) stationarity, the null hypothesis of unit roots in all variables cannot be rejected. Additionally, the PP unit root test is expected to align with these ADF results, given their similar methodologies. The following section presents correlation Matrix results.

4.3. Correlation Matrix Results

The estimated correlation results for all the variables under this study in the form of correlation coefficients, including their corresponding p-values, are presented in Table 4.

Table 4. Estimated Correlation Matrix Results

Variables	LnUNEMP	LnBOT	LnEG	LnGDPpc	LnFDI
LnUNEMP	1				
LnBOT	0.478	1			
	0.000 **	-----			
LnEG	0.157	-0.16	1		
	0.155	0.147	-----		
LnGDPpc	0.268	0.329	-0.095	1	
	0.014 *	0.002 **	0.390	-----	
LnFDI	0.106	-0.025	-0.125	0.136	1
	0.335	0.819	0.256	0.218	-----

(**) P-value significant at a 1% significance level

(*) P-value significant at a 5% significance level

The correlation coefficients presented in Table 4 provide a quantitative measure of the relationships among the study's variables. A coefficient of 0 indicates no relationship, while values between -1 and +1 reflect varying strengths of linear relationships: negative coefficients denote

inverse relationships, while positive coefficients indicate direct relationships. Coefficients closer to -1 or +1 suggest stronger inverse or direct relationships, respectively. In this study, the variables analyzed include LnUNEMP, LnBOT, LnEG, LnGDPpc, and LnFDI, with UNEMP as the dependent variable. The table shows positive correlations of 0.478 with BOT, 0.157 with EG, 0.268 with GDPpc, and 0.106 with FDI, signifying direct relationships. Notably, BOT is significant at the 1% level, and GDPpc is significant at the 5% level, while EG and FDI do not meet significance thresholds below 10%. Overall, the findings indicate direct linear relationships between UNEMP and the other variables, with only BOT and GDPpc showing statistically significant correlations, thus reinforcing the argument of a meaningful relationship between unemployment, balance of trade, and GDP per capita within the South African economy. Furthermore, the results highlight a strong positive correlation between BOT and GDPpc, addressing gaps in prior research by establishing a statistically significant connection among these variables. The following section presents cointegration and vector error correction results.

4.4. Cointegration test & Vector error correction results

The unit root and stationarity tests in section ii reveal that study variables are a mix of I(0) and I(1) integration orders, with none being stationary at I(2). This allows for the use of the ARDL test approach for cointegration to assess the long-run impact of the Balance of Trade on employment in South Africa. Following this, the VEC results will be reported and interpreted to analyze the short-run effects. First, lag order selection results are presented followed by ARDL model results.

a) Optimal Lag Order

Before proceeding with the ARDL estimation, it is essential to determine the optimal lag order. The maximum number of lags for the ARDL model was established using the VAR Lag Order Selection Criteria, with the results detailed in Table 5, which presents the lag orders calculated by various information criteria.

Table 5. Optimal Lag Order: ARDL Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-181.133	NA	7.22E-05	4.653325	4.802202	4.713014
1	199.5401	704.2453	9.94E-09	-4.238503	-3.345243*	-3.880369
2	239.1006	68.24184	6.96e-09*	-4.602515*	-2.964872	-3.945937*
3	248.2788	14.68519	1.05E-08	-4.206971	-1.824944	-3.251948
4	286.197	55.92935*	7.90E-09	-4.529926	-1.403516	-3.276459

* Indicates lag order selected by the criterion
 LR: sequential modified LR test statistic (each test at 5% level)
 FPE: Final prediction error
 AIC: Akaike information criterion
 SC: Schwarz information criterion
 HQ: Hannan-Quinn information criterion

The results for the lag order estimation confirm that the criteria selected four lags. Four lags for VAR were used as the maximum number of lags in the ARDL model, regressing the selected dependent variables under study on unemployment. The following section presents ARDL test results.

b) ARDL Test Results: Long Impact on Unemployment

This section employs the ARDL test approach to cointegration to evaluate the long-run impact of the Balance of Trade on Unemployment in the South African economy. The ARDL test results, including the lower and upper bounds along with the corresponding F-value, are presented in Table 6.

Table 6. Estimated ARDL Model tests Results

ARDL Model		Estimated F-value	
ARDL Model (1,1,0,0,1)		40.97	
		Critical Value Bounds	
Significance levels		Lower Bound I(0)	Upper Bound I(1)
10%		3.03	4.06
5%		3.47	4.57
1%		4.4	5.72
Note: critical values from Pesaran et al. (2001); Table CI (V)			
Long-run Equation: LUNEMP = -2.6584 + 0.0329*LBOT - 0.2725*LEG - 1.1608*LGDPpc +0.0116*LFDI			

Table 6 reveals that the estimated F-value for the ARDL model is 40.97, surpassing the critical value bounds at the 1 percent significance level, which leads to the rejection of the null hypothesis of no long-run impact and confirms the existence of cointegration. Thus, the variables under study BOT, EG, GDPpc, and FDI all have a long-run impact on UNEMP in South Africa. Specifically, BOT and FDI exhibit positive long-run impacts, with a 1 percent increase in BOT associated with a 0.033 percent rise in UNEMP and a 1 percent increase in FDI linked to a 0.012 percent rise in UNEMP. Surprisingly, the FDI impact contradicts expectations, likely due to the adverse effects of the COVID-19 pandemic, which resulted in significant job losses despite receiving substantial FDI. Conversely, EG and GDPpc negatively influence UNEMP, with a 1 percent increase in EG decreasing UNEMP by 0.273 percent and a 1 percent increase in GDPpc reducing it by 1.161 percent, indicating that economic production and overall welfare significantly influence unemployment trends in the region. The VEC model results are presented below.

c) VEC Model Results: Short-run Impact on Unemployment

This section presents the short-run impact analyzed using the VEC model, following the long-run results from the ARDL model. As noted by (16), the VEC model assesses the speed of adjustment for observed variables to return to long-run equilibrium, with Table 7 detailing the VEC model results from the ARDL analysis.

Table 7. Estimated ECM Results

ARDL Model (1,1,0,0,1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LnUNEMP(-1))	-0.496155	0.055561	-8.929904	0
D(LnBOT(-1))	0.016318	0.006275	2.600692	0.0112*
D(LnEG)	-0.135199	0.010444	12.94486	0**
D(LnGDPpc)	-0.575932	0.079133	-7.278031	0**
D(LnFDI(-1))	0.005763	0.004392	1.31221	0.1935
ECT(-1)	-0.496155	0.033766	-14.69388	0**
(**) denotes significance at 1% level				
(*) denotes significance at 5% level				

The estimated ECT coefficient in Table 7 is negative and significant at the 1 percent level, indicating that the speed of adjustment back to long-run equilibrium among the observed variables can be assessed. With an ECT value of -0.496, it suggests that it takes approximately two quarters, or six months, for unemployment to return to long-run equilibrium following any changes in BOT, EG, GDPpc, and FDI, allowing for the calculation of the short-run impact on unemployment for each variable. The following section presents model diagnostic test results.

d) Model Diagnostic test results

This section presents and interprets the results of the residual and stability diagnostic tests to ensure that the findings from the ARDL test and VEC model in the previous section are reliable and not spurious. Table 8 displays the residual diagnostic test results for the ARDL model.

Table 8. Estimated ECM Results

Residual Diagnostic Tests	ARDL Model (1,1,0,0,1)	
	P-value	Decision
Normality Test	0.9035*	Do not reject H_0
Serial Correlation Test	0.7857*	Do not reject H_0
Heteroscedasticity Test	0.3115*	Do not reject H_0

(*) Fail to reject the null hypothesis at 1% and 5% significance levels

All three tests Normality, Serial Correlation, and Heteroscedasticity failed to reject the null hypothesis, indicating that the variables in the ARDL model are not affected by non-normal distribution, serial correlation, or heteroscedasticity. This suggests that the results produced by the ARDL model are valid and not spurious or misleading.

5. Discussion

To address this econometric objective, both the correlation matrix and ARDL model results presented in Sections i, ii and iii, were utilized. The correlation matrix quantitatively assessed the strength of the relationship between the BOT and UNEMP, revealing a correlation coefficient of 0.478. This value signifies a substantial direct linear relationship, given that coefficients closer to -1 or +1 indicate strong inverse or direct associations. The results support. The significance of this correlation is reinforced by a p-value below the 1% threshold. Additionally, the ARDL model results established that BOT exerts a long-run positive impact on UNEMP, with a 1% increase in BOT leading to a 0.033% rise in unemployment. Furthermore, the VEC model analysis suggests that it takes approximately 62 quarters for UNEMP to return to long-run equilibrium after any change in BOT. Overall, the findings confirm a positive long- and short-run relationship between BOT and UNEMP in South Africa from 2002 to 2022. The results support (18) who argued that trade assists in the obtainability of production factors such as capital, technology, labour, and human capital across the global markets, which impacts various economic levels and trade benefits. There are adverse effects that result from free trade, such as closing infant industries since they cannot compete fully with well-founded firms from other developed countries. The results also support (18), who concluded that trade had the potential to decrease unemployment in specific industries and democratic areas but could not conclude that trade influences the unemployment level in a country significantly. Moreso, (17) conducted a study on the European Union and how China's exports impacted European jobs and revealed found that the increased susceptibility to Chinese imports caused a higher rate of workers to flow from employment to unemployment and a reduced probability of unemployed landing employment.

6. Conclusion And Recommendation

This study comprehensively examined the impact of the BOT on UNEMP in South Africa from 2002 to 2022, rooted in Adam Smith's theory of absolute advantage, which emphasizes trade as essential for economic development. The empirical literature review confirmed that BOT is a significant economic variable, especially in developing countries, and the econometric analysis revealed a substantial direct linear relationship between BOT and UNEMP, indicating that changes in the trade balance directly influence unemployment rates. The findings also highlighted the long- and short-run impacts of GDP per capita on UNEMP, illustrating the interconnectedness of economic growth and employment levels. To achieve sustainable economic growth, the study recommends that South Africa reduce its reliance on imported finished goods while boosting production of raw materials and capital goods, prioritize sectors such as agriculture, manufacturing, and mining for their labor absorption potential, invest in advanced foreign technologies to enhance local productivity, promote technology education to meet the demands of a technology-driven economy, and address entrepreneurial challenges among the unemployed. Finally, the government must resolve inefficiencies in state-owned enterprises to foster a conducive environment for industry growth and attract foreign investments. Collectively, these insights underscore the critical role of BOT in shaping employment outcomes in South Africa and provide a roadmap for policymakers aiming to enhance the nation's economic stability and improve citizens' livelihoods.

Author Contributions: Gideon F. van Rhyn conducted the research for this dissertation under the supervision of Dr. Mike Muzekenyi. Dr. Muzekenyi subsequently adapted the dissertation into this article.

Funding: This research received no external funding.

Data Availability Statement: The data can be provided upon request.

Acknowledgments: We gratefully acknowledge the support received from several sources. Milpark education provided invaluable administrative assistance, STADIO Higher Education supplied essential technical support in the form of publication fees. His combined support was instrumental in ensuring the successful completion of the research.

Conflicts of Interest: The authors declare no conflict of interest

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Sustainable Business Study and Its Presentation on the Social Network Instagram

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Abstract: This article explores the growing trend of sustainable business practices and their presentation on the Instagram social network, a platform increasingly favored by companies to communicate with their stakeholders. In the research portion of this thesis, we will conduct a content analysis of posts from selected companies and perform a sentiment analysis of their followers and profiles on Instagram.

Keywords: Sustainable Business, Instagram, Social Networks, Content Analysis, Sentiment Analysis

1. Definition and concept of sustainable business

The concept of sustainable business has evolved from early notions of corporate social responsibility to encompass broader goals, including environmental protection, social equity, and economic growth. Key milestones in shaping the modern sustainable business landscape include Rachel Carson's *Silent Spring* (1962), the establishment of the Environmental Protection Agency (1970), and the adoption of the United Nations Sustainable Development Goals (2015) [1]. Elkington introduced the *Triple Bottom Line* framework, encouraging companies to evaluate their performance across three dimensions: **profit** (economic viability), **people** (social responsibility), and **planet** (environmental sustainability). This approach aims to promote long-term business success while fostering environmental stewardship and social equity [2]. Ray Anderson (2009) expands this concept with his idea of *restorative sustainability*, arguing that businesses should go beyond merely minimizing environmental harm to actively restoring the natural resources they affect. Anderson advocates for a fundamental transformation of business practices, aligning them more closely with the planet's ecosystems [3]. Paul Hawken emphasizes the need for a paradigm shift in business operations. He critiques traditional industrial practices as inherently unsustainable, often resulting in ecological damage and social inequality. Hawken defines sustainable business as aligning economic activities with principles of ecological integrity, social justice, and economic vitality. He argues that businesses should adopt sustainability not as a charitable endeavor or regulatory obligation, but as a strategic imperative for long-term survival and profitability. This perspective recognizes the finite nature of Earth's resources and the interconnectedness of all living systems [4].

Lovins proposes a transformative framework for sustainable business grounded in four core principles:

1. **Radically increasing resource productivity:** Companies should adopt innovative technologies and practices to minimize waste and maximize the value of inputs.
2. **Shifting to renewable energy:** Utilizing renewable energy sources like solar, wind, and biomass reduces reliance on finite fossil fuels and mitigates the environmental damage caused by their extraction and use.
3. **Moving to closed-loop systems:** Businesses should transition from a linear "take-use-dispose" model to a circular economy, where materials are reused, recycled, or otherwise repurposed to minimize waste and pollution.
4. **Reinventing business models:** Lovins advocates for rethinking traditional profit-maximizing strategies. Companies should prioritize creating long-term societal value by fostering innovation, social responsibility, and environmental sustainability.

According to Lovins, integrating these principles into business practices not only protects the planet but also drives economic growth and enhances human well-being. This approach empowers companies to thrive in harmony with nature while contributing to a more sustainable future [5].

Citation: Schlosserová, Z. & Hruzová, K. (2025) Sustainable Business Study and Its Presentation on the Social Network Instagram. *Journal of Economics and Business Issues*, 5(2), 54-65.

Received: 24/05/2025

Accepted: 18/07/2025

Published: 31/07/2025

2. The growing importance of sustainable business

Organizations can no longer overlook the impact of climate change on supply chains, while rising customer expectations demand that companies adopt meaningful sustainability measures. Studies show that businesses operating sustainably foster innovation, build brand equity, and achieve higher profitability [6]. Sustainable business practices are critical not only for protecting the environment but also for promoting social well-being and ensuring economic resilience. Growing environmental awareness among consumers and businesses has underscored the urgent need to address climate change and other environmental challenges. Consumer preferences have shifted markedly towards ethically produced, environmentally friendly products, placing increased pressure on companies to adopt greener practices. Governments worldwide are introducing stricter environmental regulations, compelling organizations to transition to sustainable models to remain compliant. In addition, nations are prioritizing investments in businesses that integrate sustainability into their operations. Advances in technology have also facilitated the adoption of sustainable practices, making them more accessible and cost-effective [7].

Global initiatives such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs) further incentivize businesses to incorporate sustainability into their strategies. These frameworks encourage organizations to align their operations with global efforts to combat environmental and social challenges. Moreover, sustainability serves as a strategic approach to risk management. By addressing risks related to resource scarcity, regulatory changes, and reputational damage, companies can enhance their long-term viability and resilience. In essence, the transition to sustainable business is driven by a convergence of environmental, social, and economic factors. This movement represents not just a moral or regulatory obligation but a strategic imperative for businesses aiming to thrive in a rapidly evolving global landscape.

3. The impact of sustainable business

Societies rely on collective action, as individuals alone cannot effectively address the sustainability challenges facing the global community [8]. Sustainable societies adopt a long-term perspective, prioritizing enduring goals and fostering strong relationships and networks over short-term profitability [9]. Sustainable businesses play a crucial role in supporting social and environmental development while maintaining a balance between economic growth and the preservation of the planet's resources. They prioritize resource efficiency, the adoption of renewable energy, and ethical working conditions. These practices not only minimize ecological footprints but also contribute to creating a more equitable society [10]. The positive impacts of such businesses include increased biodiversity, reduced greenhouse gas emissions, and enhanced community well-being. Moreover, sustainable businesses often lead by example, setting industry benchmarks that encourage other companies to adopt greener practices. Their efforts amplify positive outcomes on both local and global scales. By committing to sustainability, these businesses demonstrate that economic success can align with environmental stewardship and social progress, paving the way for a more inclusive and sustainable future [11].

However, sustainable businesses face numerous ethical challenges. Ethics are integral to the concept of sustainability, ensuring that economic activities contribute positively to society and the environment. Meanwhile, consumers are also evolving in their preferences, increasingly applying ethical and environmental criteria to their purchasing decisions. Businesses that recognize this shift and offer ethical or greener alternatives differentiate themselves through their organizational values, not merely through marketing strategies. Consumers, employees, and investors are now more inclined to support sustainable initiatives, aligning themselves with brands that embody strong values and sustainable policies. This growing alignment underscores the significance of integrating ethical and environmental considerations into business strategies, ultimately shaping a more conscientious and value-driven marketplace [12].

4. Social networks and the promotion of sustainable business

Social media offers sustainable companies direct channels to communicate their values, initiatives, and innovations. This transparency fosters brand trust and engagement with current and future customers. By leveraging social media, sustainable companies can build and maintain communities of supporters. Social media facilitates discussions, shares success stories, and supports community-driven sustainability initiatives. At the same time, companies that effectively use social media to highlight their sustainability efforts can increase brand loyalty among environmentally and socially conscious consumers. They provide valuable information about preferences, trends, and offer direct feedback from consumers, allowing companies to tailor their products, services, and communications to market demands.

Finally, social media serves as a platform for sharing ideas, fostering innovation, and collaborating with other organizations or individuals who want to contribute to sustainability. Integrating

social media into the marketing strategies of sustainable companies is not only beneficial but also essential in today's digital age, expanding the reach of the company, strengthening its identity and connecting marketing strategies with key principles of sustainability and corporate responsibility. Social media is an effective tool for sustainable businesses to promote their green and socially responsible initiatives. By using strategic communication, engaging with communities, gathering consumer insights and directly addressing challenges, businesses can effectively use social media to achieve sustainability goals and build a more sustainable future [13].

Businesses can promote sustainability through social media marketing by sharing their sustainable practices with customers. This approach allows them to demonstrate their commitment to sustainable practices and attract customers who value a green approach. This will help businesses build a strong brand reputation and increase customer loyalty. Customers are more likely to support businesses that prioritize sustainability and align with their values [14]. They also serve as a direct channel for receiving feedback from consumers on sustainability initiatives, allowing businesses to adapt and improve their products or services based on real-time input. Therefore, we foresee the contribution of social media as a trigger and support tool for disseminating knowledge and information to promote the adoption of green lifestyles within a value co-creation approach.

Sustainability leaders are now coming up with creative ways to reach consumers. Below, we offer suggestions for individual strategies, along with successful examples of companies [15]. Share data on the company's sustainability activities: If a brand has sustainability initiatives, their results should definitely be shared on social media. Specificity in the examples given: companies have gotten into trouble with authorities because they couldn't prove that the products they claim are sustainable actually are. More specifically, if companies clearly state in their posts why their products are sustainable, these posts will resonate more with their social media audience.

Communicating about sustainability: It's important to highlight the specific actions and initiatives the company is taking to promote sustainability and how these actions contribute to the overall environmental, social and economic impact of the product. It's then important to take customer feedback into account and constantly look for ways to improve and innovate products and services from a sustainability perspective. Share company goals publicly: Even if companies haven't yet achieved their sustainability goal, it's still worth sharing benchmarks on social media. If companies want to be seen as sustainable, sharing goals is important, and social media audiences see this as action.

Using sustainability in recruiting: According to a 2019 Fast Company survey, nearly 40% of millennials said they chose a job in the past because the company had a better sustainability record than the competition. Hiring campaigns often use sustainability as a way to increase interest among potential employees, thereby attracting them.

Show commitment to the environment: People used to buy used clothes mainly out of necessity or when looking for a bargain, but as sustainability has become more important in the fashion industry, more and more brands are selling old collections.

5. Content of social networks of sustainable companies

Sustainable businesses use social media to share content that highlights their sustainability goals, achievements, and challenges. This includes sharing stories about green products, sustainable sourcing, and community engagement initiatives. The content often revolves around showcasing their commitment to environmental, social, and economic principles, as well as their sustainability and corporate responsibility efforts. It must reflect the company's values, commitment to sustainability, and efforts to create a positive social, economic, and environmental impact.

It is important to have quality content; in the book "Jak na síť" (How to Network), the authors (Vyhnanáková, et al., 2019) created 5 basic types of content:

Entertainment, inspiration, and lifestyle: users most often go to social media to relax, and that is why entertaining content is the most attractive. It should be content that leaves the user amazed, surprised, inspired, or entertained. At the same time, the content should still be related to the brand. A common problem with this type of content is that users get used to it and anything related to the business will annoy them.

Education: this category includes professional articles, research, industry information, or tips and tricks. Everything that broadens users' horizons. Such posts have two basic functions: they strengthen the brand's expertise and educate users. People like to use services or buy products from people who understand their industry, so this type of content should be preferred for sustainable businesses.

Behind-the-scenes, testimonials: as the authors say, everyone wants to see behind-the-scenes, and this is an ideal opportunity to better present the company. There are no limits to how far a company can let users in, but behind-the-scenes content can include, for example, the company's history, work achievements, who the company's employees are, or client references.

Help: this type of content is often displayed for sustainable companies. Brands show how the product will help the user or the public. They usually respond to the most common problems of users. This content is created by itself, you just need to listen to the users.

Sales, product and discounts, competitions: writing good and non-violent sales posts is difficult, and therefore the authors recommend using this type of content only if a solid base of users or fans has already been created. These posts help to present the products and their use. They can include various discounts and discount codes [16].

Chomsky (2023) adds one to these types of content that is very popular today:

Collaboration with influencers: who have a large following in a specific industry, is currently an excellent way to reach the target group. Influencers create content that feels natural and effectively addresses the given audience [17].

Based on the above theoretical background, we decided to conduct research that analyzes the content of the Instagram social network of profiles of sustainable companies selected by us.

6. Research methodology

The main goal of the research is a content analysis of selected profiles of sustainable companies on the social network Instagram, as well as an analysis of the sentiment of comments that followers of selected companies leave under their posts.

Sentiment analysis, also known as attitude analysis, is the process of identifying, extracting, and quantifying subjective information primarily from textual data. In practice, this means analyzing people's opinions, feelings, evaluations, attitudes, and emotions toward given subjects. The analysis focuses primarily on opinions that express or imply positive or negative feelings [18]. In our case, we will focus on emotions in text form – in comments.

We also focused on the content of shared posts, which we evaluate through content analysis. Krippendorff (2018) defines content analysis as a systematic and objective approach to analyzing text, audio, visual, or any other form of communication. For content analysis to be successful, it is important to define clear coding schemes and categories that are consistent with the research goals and theoretical framework [19].

The research material consists of selected sustainable companies. We chose the clothing industry, which is considered one of the biggest polluters. If nothing changes, the fashion industry will produce a quarter of CO₂ emissions by 2050. People buy around 80 billion pieces of clothing every year, which seriously burdens the environment with their production. This is also why many clothing companies have started to deal with sustainability [20]. The research file was selected based on the ranking compiled by Sustainability Magazine, which defined the best clothing companies of 2023. Although the clothing industry is known as one of the biggest polluters, contributing to 10% of the pollution that causes climate change, there are many global brands that are eager to make a difference [21]. We selected six companies from the list of ten companies. The selected companies are: *Patagonia, Tentree, Reformation, Pact, Quince, Whimsy + Row*.

Data collection method from the social network Instagram of selected companies, we analyzed user reactions during one month (20.1.2024 - 20.2.2024), the file is sufficiently extensive, as these companies add posts on a daily basis. The data is stored in an Excel table to ensure its clarity. The table includes the following data: brand, format and content of the post, user comments and the sentiment category assigned to them. If the comment also includes an "emoticon", the category is much easier for us to classify, as it already predicts the author's sentiment. As mentioned above, we classify the data into three categories: positive (+1), neutral (0) and negative (-1) comment.

Značka	Formát	Obsah	Komentár	Kategória
tentree	Infografika	Edukácia	Amazing 🙌🙌	+1
			🙄🙄	+1
			What a fun infographic!!!	+1
			Is just for canada?	0
			I like this idea. However, why does men's clothing earn \$5 more credit than women's? :(If you use the argument of less material, you charge \$40 for both men's and women's tshirts. It's similar to the pink tax, wage gap, and other financial differences regarding gender. Please consider EQUALIZING credit for adult clothing. Women are not less than, this subconsciously says otherwise :(-1
tentree	Reelsvideo	Edukácia	Are there any groups join located in Northern California to help with planting?	0
			Omg!!!! This is amazing ❤️ love this initiative	+1
			Oooooo can't wait to see this 🙌	+1
			❤️❤️ okay! I want to plant the trees, here in Canada! Where can people sign up??	+1
			🙌🙌❤️	+1
			🙌❤️	+1
			🙌🙌🙌🙌🙌🙌	+1
			❤️❤️❤️❤️❤️❤️❤️❤️	+1
love it 😊!	+1			

Figure 1. Research material - sentiment analysis (sample).

Source: Own processing

In the case of content analysis, we base our work on data from the Instagram social network of selected sustainable companies. We work with data collected over the course of one month (January 20, 2024 – February 20, 2024). In this case, too, we collect data into an Excel spreadsheet. The spreadsheet includes the following data: ranking, brand, social network, content and format of the post, number of comments and likes. We also monitor the number of comments and user reactions to individual formats and content.

Poradie	Značka	Sociálna sieť	Obsah	Formát	Komentáre	Likes
1	Quince	Instagram	Produkt	Fotografia	14	372
2	Quince	Instagram	Produkt	Fotografia	21	315
3	Quince	Instagram	Produkt	Reelsvideo	36	557
4	Quince	Instagram	Produkt	Reelsvideo	19	278
5	Quince	Instagram	Produkt	Fotografia	10	253
6	Quince	Instagram	Produkt	Reelsvideo	14	213
7	Quince	Instagram	Produkt	Reelsvideo	38	406
8	Quince	Instagram	Influencer	Reelsvideo	24	215
9	Quince	Instagram	Produkt	Reelsvideo	8	258
10	Quince	Instagram	Produkt	Reelsvideo	10	207
11	Quince	Instagram	Influencer	Reelsvideo	14	221
12	Quince	Instagram	Produkt	Reelsvideo	14	178
13	Quince	Instagram	Influencer	Reelsvideo	27	314
14	Quince	Instagram	Produkt	Fotografia	17	232
15	Quince	Instagram	Produkt	Reelsvideo	2	177

Figure 2. Research material – Instagram content analysis (sample).

Source: Own processing

The data evaluation method that we used on the data we collected is frequency analysis, which is the basis of quantitative research. We classify the amount of data under their individual categories and reduce them using sums. We interpret the obtained results using graphs and numerically to make them better recognizable.

As mentioned above, sentiment evaluation is the process of identifying, extracting and quantifying the emotional tone of the text expressed as positive, negative or neutral. In our rigorous

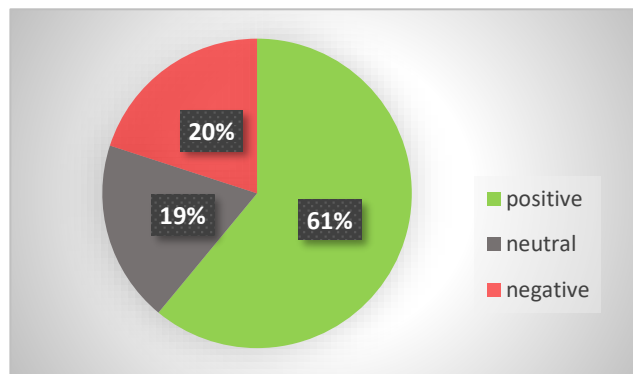
work, we used sentiment analysis to evaluate comments on given posts on the social network Instagram. Based on individual codes (+1, 0, -1) and their corresponding values, we classified individual comments.

Content analysis is the process of systematically examining content in order to gain a deeper understanding of its structure, patterns and themes. In our work, we focused on content analysis as a means of identifying key formats and key content used by sustainable companies on social media platforms Facebook and Instagram. We used techniques such as content coding and frequency analysis to identify key types of content in posts.

We divided the posts into groups based on the content shared: lifestyle; influencer; education; product; sale; motto; inspiration; event; testimonial; giveaway; entertainment or promo code. We based our analysis on current content trends on social media [22].

7. Research results

Research Question 1: How are selected sustainable companies perceived by social media users based on the sentiment expressed in comments on Instagram?

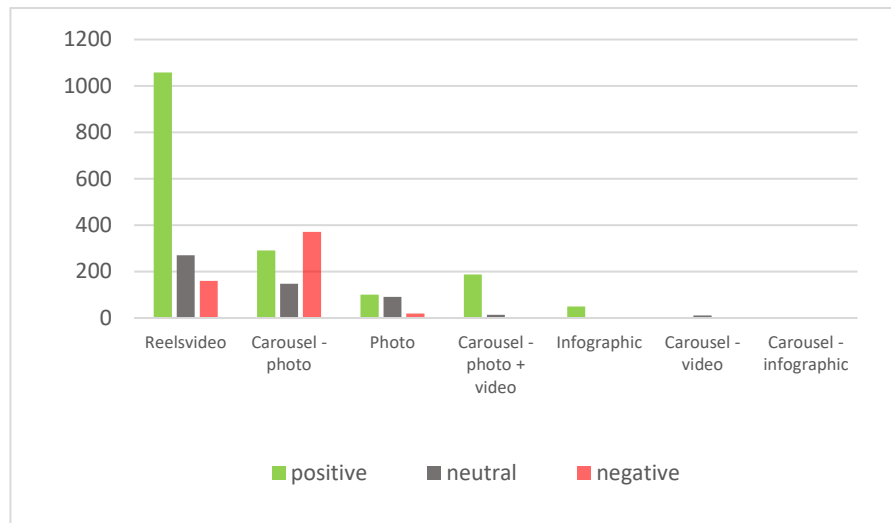


Graph 1 Sentiment Analysis: Perception of Sustainable Companies on Instagram

Source: Own processing

The sentiment analysis of Instagram comments regarding selected sustainable companies reveals that public perception is predominantly positive. Of the total comments analyzed, 61% reflect positive reactions, indicating that a majority of social media users view these companies' posts favorably. Neutral comments account for 19%, suggesting a segment of users who remain more reserved or inquisitive about the companies' activities. This category also includes specific user inquiries posed in the comments. Negative comments make up 20%, highlighting the presence of a critical audience expressing reservations about the companies' practices or communications. These findings underscore that, while positive sentiment dominates, addressing neutral and critical feedback is essential to identify areas for improvement, foster dialogue, and enhance overall brand trust.

Research Question 2: How are individual post formats perceived by users on social networks based on the sentiment expressed in comments on Instagram?



Graph:2 Sentiment Analysis: Perception of Instagram Post Formats

Source: Own processing

The analysis indicates that Instagram post formats elicit varied responses from users. **Reels and videos** emerge as the most positively received, with a significant majority of positive comments (1,058) compared to negative (270) and neutral (160). **Carousel posts with photos** follow, generating a higher number of negative comments (371) than positive (291) and neutral (101). Similarly, **photo posts** garner favorable feedback, with positive comments (148) surpassing neutral (91) and negative (19) ones.

Other formats, such as **Carousels combining photos and videos, infographics, and Carousels with videos only**, receive fewer overall comments but maintain a positive sentiment predominance. Notably, **infographics**, despite their lower engagement levels, attract very few negative responses, suggesting they are generally well-received, though less discussed than more dynamic formats.

Overall, Instagram users exhibit a clear preference for visual and dynamic content, with **Reels and videos** being particularly effective in generating positive reactions. While negative sentiment exists, it remains relatively limited compared to positive and neutral responses. These findings underscore the value of engaging, visually dynamic content for sustainable companies aiming to connect with their audience.

Research Question 3: How are individual types of post content perceived by users on social networks based on the sentiment expressed in comments on Instagram?

	positive	neutral	negative
Education	618	72	285
Influencer	282	42	25
Product	287	241	39
Lifestyle	180	121	74
Testimonial	157	21	4
Motto	28	9	6
Fun	9	14	17
Sale	15	5	0
Inspiration	6	11	2
Event	9	0	0

Table 1. Sentiment analysis: perception of the content of instagram posts

Source: Own processing

Educational posts are the most positively received category on social networks, with a significant majority of positive comments (618) compared to negative (72) and neutral (285). This indicates a strong engagement and favourable reception of educational content among users. **Influencer posts** and **product posts** also generate a high number of positive comments (282 and 287, respectively); however, they also attract relatively higher numbers of negative comments (42 and 39) compared to other categories. This suggests that while these posts are popular, they may provoke more controversy or differing opinions. **Lifestyle** and **testimonial posts** show a similar distribution of positive and neutral comments, reflecting a generally favourable but more reserved user response. Posts categorized as **entertaining content** receive fewer positive comments overall. Meanwhile, **sales posts**, **inspirational content**, and **posts about events** tend to garner a low volume of comments, potentially indicating reduced user interest in these types of content.

Research Question 4: What format of posts within sustainable companies gets the most likes from users on the social network Instagram?

	Number of likes
Reelsvideo	414910
Carousel - photo	230462
Photo	74243
Carousel - photo + video	36456
Carousel - video	6778
Infographic	1648
Carousel - infographic	118

Table 2. Occurrence of formats in relation to user interaction (likes)

Source: Own processing

The total number of posts on the Instagram social network of the six selected companies was 146 posts over a period of one month. No post was duplicated and shared multiple times. All shared posts of the selected sustainable companies were included in this research. From the graphic display, we can clearly see that the most preferred format in terms of liking posts is the Reelsvideo format (414,910 likes). The results indicate that users prefer this format to static formats. Moving formats with music displace more traditional formats such as photos or infographics and are very engaging and resonate with Instagram users. An interesting finding concerns the Carousel format, which allows you to present multiple images or graphics in one post, but forces users to click through the content. The user is therefore not just a passive recipient, but wants to learn more about the issue. Sustainable companies are trying to reach and target users who are interested, as we demonstrated in the theoretical part. Other formats, such as single photos, combined carousels, or infographics, have significantly lower like counts, indicating that they are less preferred among sustainable companies on Instagram.

Research Question 5: What format of posts within sustainable companies has the highest number of comments from users on the social network Instagram?

	Number of comments
Carousel – photo	15625
Reelsvideo	4414
Photo	3630
Carousel - photo + video	227
Infographic	84
Carousel – video	18
Carousel – infographic	4

Table 3. Occurrence of formats in relation to user interaction (comments)

Source: Own processing

The Carousel - photo post format received the highest number of comments from users on the Instagram social network with 15,625 comments. This type of post shows the highest level of interaction compared to other formats, which suggests that presenting multiple photos in one post can arouse greater interest and stimulate discussion among users. The carousel format allows companies to present a series of photos at once, which are thematically aligned, which provides richer context and can support deeper discussion among users. This may be the result of a change in Instagram's algorithm, as we mentioned in the theoretical part of the thesis, Instagram prefers the carousel format. At the same time, the Reelsvideo format follows with 4,414 comments, which is less than the photo carousel, but still represents a significant number of interactions, which indicates the popularity of video content. Reelsvideos offer a dynamic and often entertaining way to share information. The individual photos received 3,630 comments, proving that even simple visual content can be effective in generating user comments. Other formats have significantly lower comment counts, signaling that these types of content are less engaging for Instagram users in terms of discussion and interaction.

Research Question 6: What content of posts within sustainable companies do users like the most on the social network Instagram?

	number of likes to content
Education	327764
Lifestyle	189901
Influencer	113537
Product	61065
Fun	23090
Motto	15829
Inspiration	8001
Event	7870
Sale	7140
Testimonial	6836
Giveaway	3327
Promo code	255

Table 4. Content occurrence in relation to interaction (likes)

Source: Own processing

In the selected research set (196 posts) on the social network Instagram, the content of the post focused on Education (327,764 likes) dominates. This also confirms the claims in the theoretical part of the paper that consumers who are interested in sustainability are people who are educated and are not just passive recipients. Instagram users have a high preference for content that provides information and education about sustainability and related topics. This is followed by Lifestyle content with 189,901 likes, which indicates that posts that integrate sustainability into everyday life and offer inspiration for lifestyle are also very popular among users. Posts with content from Influencers (113,537 likes), who are a current phenomenon on social networks and can attract the attention of social network users, also have a strong response. This also points to the importance that these personalities have in spreading awareness about sustainability. The categories Sale, Testimonial, Giveaway, and Promo Code received the fewest likes, which may indicate that direct marketing and calls to action are not as effective on Instagram as content that is more focused on brand values and builds community.

Research Question 7: What content of posts within sustainable companies do users comment on the most on the social network Instagram?

	number of coments to content
Education	17493
Giveaway	3328
Influencer	887
Lifestyle	860
Product	819
Testimonial	205
Event	153
Sale	87
Inspiration	67
Fun	54
Motto	49
Education	17493

Table 5. Content occurrence in relation to user interaction (comments)

Source: Own processing

According to the results collected from the available data of the graph, it was shown that users on the social network Instagram comment the most on the content of posts related to Education with a total of 17,493 comments. This shows that educational posts generate a high level of engagement and are likely to be perceived as valuable and stimulating discussion among users. The second most commented type of content is giveaways - competitions with 3,328 comments, which indicates that competitions are an effective way to encourage user interaction. Posts from influencers with 887 comments indicate that influential personalities on social networks can effectively engage their audience in the discussion about sustainability. Other forms of content received significantly fewer comments, which indicates that these topics may not be as stimulating for users to discuss as educational content or interactive competitions.

8. Conclusion

Based on the data presented, our research concludes that social media users generally hold a positive perception of companies focused on sustainability. This favorable view is supported by the high number of positive reactions and comments on posts related to sustainable practices.

Educational content that effectively communicates sustainable initiatives and their significance demonstrated particularly high levels of interaction and engagement, as evidenced by increased numbers of likes and comments.

The **sentiment analysis** of Instagram comments about selected sustainable companies reveals that the majority of users appreciate these companies' sustainable initiatives and social responsibility. This indicates a strong association between sustainability and positive brand perception, which is crucial for building and enhancing brand strength in the public eye.

The **content analysis** further highlights notable differences in user engagement based on post formats. Dynamic content such as **Reels videos** and **Carousel posts** achieved significantly higher "like" metrics, reflecting greater user interaction compared to static single-content posts.

These findings underline the effectiveness of Instagram as a platform for sharing sustainable initiatives and engaging audiences. Frequent posting and the ability to generate user responses in the form of likes and comments demonstrate the platform's potential to amplify sustainability-focused communication.

We believe that this research offers valuable insights into the growing importance of sustainable business and the increasing role of social networks in corporate communication. The results highlight innovative strategies that companies can adopt to align with today's trends and enhance their sustainability messaging.

Conflict of interest

No conflict of interest was reported in this work.

Author contributions

All authors had approved the final version.

Acknowledgment

The article was submitted for publication with the help of the VEGA 1/0315/25 project.
The article was submitted for publication with the help of the UGA IV/4/2025 project.

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