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An Econometric Study on the Effect of E-Marketing on Export Volumes via Online Opportunities: Evidence from Algeria's Cement Industrial Group (GICA), Q1-2018 to Q2-2024

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Abstract:

Despite the recognized role of digitalization in enhancing export performance, empirical evidence on the statistical significance of e-marketing indicator (EMI) s in heavy industry remains scarce. This study investigates their impact on non-hydrocarbon export volumes within Algeria's cement industrial group GICA. Both simple and multiple linear regression analyses were applied, supported by significance tests (F-test, Wald test) and diagnostic checks of residual normality, homoscedasticity, and independence. This methodological framework ensures the reliability of the empirical analysis.

Findings reveal that most e-marketing indicators exert a significant and positive influence on export performance, reinforcing institutional competitiveness. in contrast, the customer satisfaction index—measured by complaint rates—did not reach statistical significance, underscoring its limited explanatory role. the predictive capacity of model 7 further demonstrates that reliance on e-marketing (EM) fosters gradual and sustainable growth in non-hydrocarbon exports up to Q2-2026, despite some variability after Q3-2025 due to external market dynamics.

Overall, the study provides strong evidence that e-marketing indicators constitute a strategic driver of sustainable export development.

Keywords: marketing; electronic export marketing; bidirectional brand–importer interaction; enhancement of export volume via online opportunities; GICA industrial group.

JEL Classification Codes : F19, F23, L25, L81, O32, M16, M21, M31.

I. INTRODUCTION

Algeria, like many resource-dependent economies, faces the strategic challenge of diversifying its revenue streams beyond hydrocarbons (Atmani, 2023). In this context, industrial sectors such as cement production emerge as potential drivers of non-hydrocarbon export growth (Hakmi, Dahou, & Merrakchi, 2023). With the rapid pace of digital transformation, e-marketing has become a critical instrument for firms seeking to penetrate global markets and expand their customer base (Chaffey, Dave ; Smith, PR, 2012).

Despite growing interest in this field, empirical studies that statistically link e-marketing components—such as website visits, online orders, foreign customer acquisition, geographic reach, shipment costs, and customer satisfaction—to export volumes remain scarce, particularly in the Algerian context. This study therefore addresses this gap by conducting an empirical analysis of the impact of e-marketing on export volumes within Algeria's Cement Industrial Group (GICA) over the period Q1-2018 to Q2-2024.

The research aims to provide a rigorous assessment of the relationship between independent and dependent variables, offering practical insights that can inform national marketing strategies and strengthen the international competitiveness of algerian firms in non-hydrocarbon markets.

Literature Review:

The Literature Review section aims to critically examine and synthesize prior studies relevant to the research topic, highlighting their key findings and methodological limitations, and ultimately identifying the research gap that this study seeks to address:

Table (01): Comparative Analysis of Prior Studies and the Current Study.

Study & Source	Focus	Methodology	Key Findings	Limitations	Contribution of Current Study
(Dong, , He, & Blut, 2024)– International Marketing Review	Digitalization& export performance	Meta-analysis, SEM	Digitalizationenhancesexports ;contextmatters	No focus on specific e-marketing indicators	Tests direct statistical link between defined indicators and export volumes
Heidarizad et al. (2024) – Meta-Analytic Review	E-commerce & export growth	Meta-analysis	E-commerce supports exports, resultsvary	Indicators not disaggregated	Disaggregates indicators (websitevisits, orders, costs, ...etc.)
(Erum, Rafique, & Ali, 2017)– SMEs in Pakistan	E-marketing adoption & export performance	Regression analysis	Positive effect of adoption	Limited to SMEs, single country	Applies to industrial complex (GICA), broader sector
(Wanying , 2025)– Cross-Border E-Commerce	Digital marketing & brand internationalization	Difference-in Difference	Enhances brand presenceglobally	Focused on branding, not export volumes	Links brand visibility with measurable export growth
(Jyoti & Bijay Prasad , 2024) – Global Business and Organizational Excellence	Digital marketing & international trade	Mixed methods	Strong link between digital marketing & trade success	Did not test statistical significance of specific indicators	Establishes significance at α= 0.05 with predictive modeling

Source: Prepared by the researchers based on the **literature review.**

Extracted Research Gap:

Despite extensive evidence that digitalization and e-commerce enhance export performance, prior studies have rarely tested the statistical significance of specific e-marketing indicators (EMI) at α= 0.05, nor have they examined their predictive capacity over time within a heavy-industry context. This study addresses that gap by focusing on the Algerian cement industrial group (GICA), disaggregating key indicators (website visits, online orders, international customers, geographic expansion, shipment costs, and customer satisfaction), and demonstrating their collective impact on export-volume development through online opportunities.

Would you like me to also **reframe this into a "literature review" section draft** (with headings and flow) so it can be directly inserted into your manuscript? that way, it will read seamlessly as part of the paper.

Problem Statement:

Amid ongoing digital transformation, the key research problem concerns the extent to which e-marketing (EM) fosters algeria's non-hydrocarbon exports. despite increasing interest, empirical evidence linking e-marketing indicators (EMI) to export volumes remains limited. accordingly, the study formulates the following research problem: **to what extent does e-marketing influence the export development of algeria's cement industrial group (gica) through online export opportunities during the period Q1-2018 to Q2-2024?**

Research Questions:

1. Do website visits significantly affect export volumes at α= 0.05?
2. Do online orders contribute to export growth at α= 0.05?
3. Does the acquisition of international customers enhance export expansion at α= 0.05?
4. Is geographic market reach positively associated with export development at α= 0.05?
5. Do shipment costs significantly influence export volumes at α= 0.05?
6. Does customer satisfaction (complaints) exert an independent effect on export development at α= 0.05?

Hypotheses :

1. **H_{01}:** Website visits have no significant effect on export volumes at α= 0.05.
2. **H_{02}:** Online orders have no significant effect on export volumes at α= 0.05.
3. **H_{03}:** International customer acquisition has no significant effect on export volumes at α= .05.
4. **H_{04}:** Geographic market reach has no significant effect on export volumes at α= 0.05.
5. **H_{05}:** Shipment costs have no significant effect on export volumes at α= 0.05.
6. **H_{06}:** Customer satisfaction has no significant effect on export volumes at α= 0.05.
7. **H_{07}:**(Main Hypothesis): E-marketing, through its combined indicators, exerts no statistically significant effect on the export development of GICA at α = 0.05.
8. **Significance of the Study:**

The study highlights the global digital transformation reshaping trade, intensified by COVID-19, which increased demand for efficient marketing solutions. Within this context, e-marketing (EM) emerges as a strategic instrument to boost Algeria's non-hydrocarbon exports. The case of GICA illustrates how digital practices enhance competitiveness and support the national goal of achieving USD 29 billion in non-hydrocarbon exports by 2030.

Methodology:

To address the research problem, this study employed a multi-method design combining descriptive and analytical approaches. A case study of Cement Industrial Group (GICA) was conducted using interviews, observation, and SEMrush data. Hypotheses were tested and findings synthesized, generating recommendations to enhance non-hydrocarbon export performance and advance scholarly understanding of industrial dynamics.

Data Collection Instruments:

1. Interviews and direct observation yielded qualitative and quantitative insights into (EM) practices.
2. Technical website performance metrics were obtained via SEMrush.
3. A dataset of 26 quarterly observations covering the period Q1-2018 to Q2-2024 was compiled.

Variables :

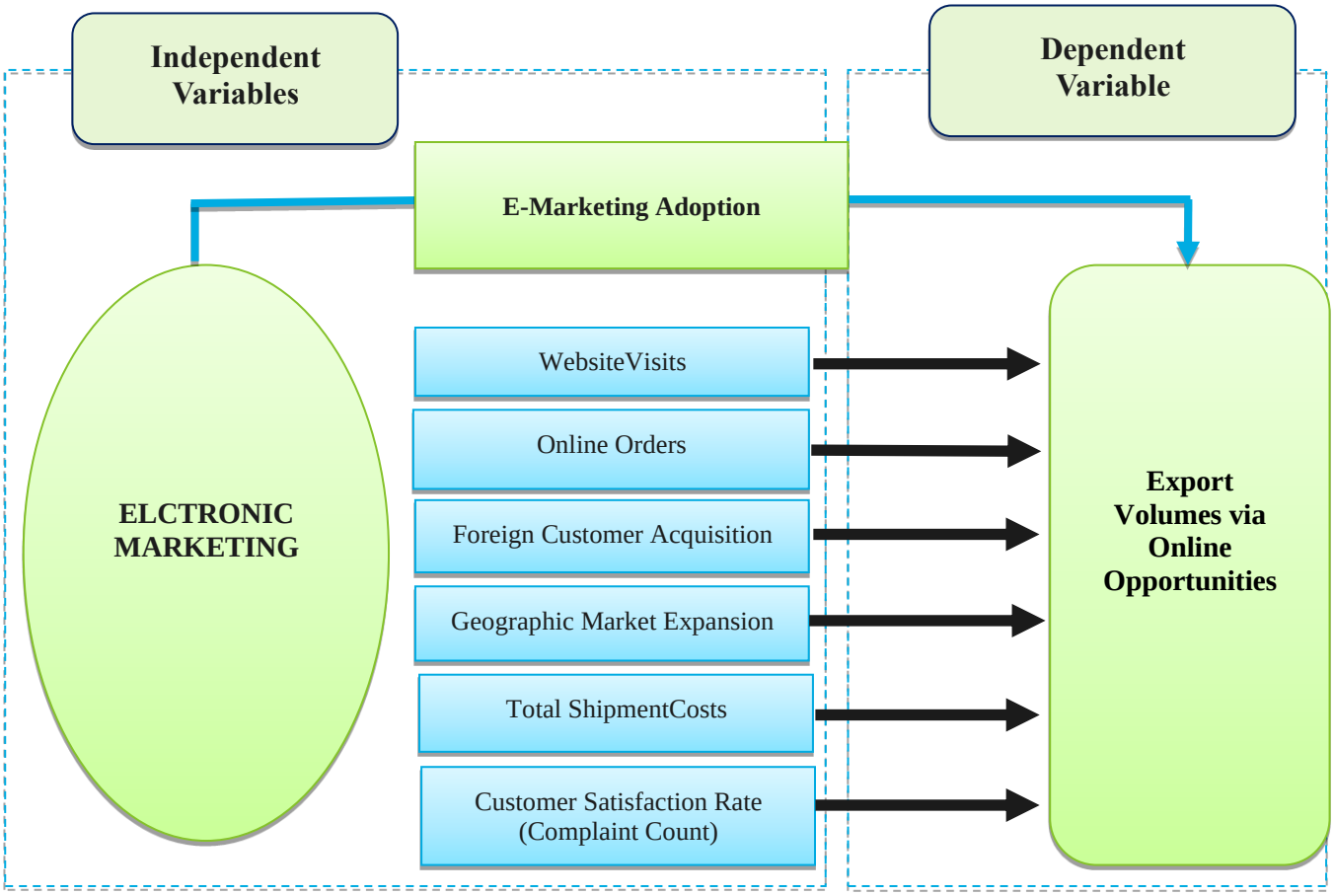
1. **Independent variables:** website visits, online orders, international customer acquisition, geographic reach, shipment costs, and customer satisfaction.
2. **Dependent variable:** export volumes generated through online export opportunities.

Study Model:

A hypothetical model, grounded in prior literature and the study's framework, was designed to test the relationship between e-marketing indicators (EMI)) and export volumes through digital

opportunities. It highlights statistical validation using advanced analytical tools and shows how digital infrastructures strategically shape a sustainable competitive trajectory for industrial exports.

Figure (01): illustrates the study model



Source: Prepared by the researchers.

Statistical Treatment:

Data were processed using EViews 10, with hypotheses tested at $\alpha = 0.05$. This framework enabled assessment of the relationships between independent and dependent variables, individually and collectively, thereby reinforcing the study's empirical rigor.

Statistical Models:

The study employed several statistical models to assess the impact of (EM) on export volumes:

- **Linear Regression:** The significance of relationships was tested using both simple regression (single independent variable) and multiple regression (several independent variables).
- **Wald Test:** Utilized to verify whether regression coefficients differ significantly from zero, thereby confirming the strength of relationships between independent and dependent variables.
- **Predictive Models:** Implemented to forecast future values of the dependent variable under changes in independent variables, enhancing adaptability to evolving conditions and supporting data-driven decision-making.

II. THEORETICAL BACKGROUND:

E-marketing has evolved from a promotional tool into a strategic system reshaping international trade. It now serves as a primary channel for market expansion and competitiveness. Within this context, the conceptual framework clarifies the studied variables and their alignment with the overarching objective of developing Export Volumes via Online Opportunities.

1. **Competitive Advantage Theory:** firms adopting digital tools can create sustainable competitive advantages by reducing costs, improving customer reach (Obeidat, 2021), and expanding into international markets (Büşra & Hakan, 2023).

2. **Transaction Cost Theory:** e-marketing (EM) reduces search, negotiation(Ziliang & Zeyu, 2016), and contracting costs, thereby facilitating cross-border trade and increasing export volumes(Karaboğa & Güngör, May 2021).
3. **Innovation Diffusion Theory:** explains how firms adopt digital technologies through stages maurizio et al, (2024), from experimentation to widespread adoption, reflecting organizational adaptability to global transformations(P, Kotler; H, Kartajaya; I, Setiawan, 2021).
4. **International Marketing Theory:** highlights that e-marketing (EM) tools represent a modern extension of traditional marketing practices (Jyoti & Bijay Prasad , 2024), offering faster and more cost-efficient access to multiple markets(Wanying , 2025).
5. **Internationalization Theory:** suggests that industrial firms pursue gradual expansion beyond national borders (Cha, Kotabe, & Wu , 2023), with e-marketing (EM) acting as a catalyst by reducing geographical and cultural barriers (Wanying , 2025).
6. **Omnichannel Digital Marketing Model:** emphasizes the integration of multiple digital channels (websites, social media, e-commerce platforms) to create a seamless customer experience (Sinkovics & Sinkovics, 2020), thereby enhancing export opportunities (World , 2022).
7. **Perceived Value Theory:** indicates that international customers decisions are shaped by perceived value (Mattos, Casais, & Braga, 2021), which e-marketing (EM) strengthens through transparency, personalization, and accessibility (Dong, , He, & Blut, 2024).
8. **Resource-Based View (RBV):** considers e-marketing indicators (EMI) as strategic resources that enhance competitiveness and export performance (Erum, Rafique, & Ali, 2017).
9. **Dynamic Capabilities Framework:** underlines firms' ability to adapt marketing strategies to evolving global conditions (Wanying , 2025), reinforcing sustainability in export growth (Asif & Wu, 2022 Sep 28).

These theories provide the foundation for linking independent variables (website visits, online orders, foreign customer acquisition, geographic expansion, shipment costs, customer satisfaction) to the dependent variable (Export Volumes via Online Opportunities). They demonstrate that e-marketing (EM) adoption is not merely a technical choice but a strategic framework that enhances competitiveness and supports national economic development goals (Philip & Keller, 2016).

Accordingly, **export e-marketing (EM)** can be defined as: A comprehensive strategic framework in which industrial firms employ digital platforms, analytics, and integrated communication channels to strengthen export performance. (EM) reduces transaction costs, expands foreign customer bases, facilitates entry into new markets, and enhances perceived value among international buyers. It thus transcends its technical function to become a strategic enabler of sustainable export growth and a contributor to national economic development goals.

Operational definition of study variables:

This study outlines variables forming the theoretical and empirical basis for evaluating e-marketing's impact on Algerian firms' export performance.

1. Dependent Variable

- **Export Volumes via Online Opportunities:** This variable stands as the ultimate indicator of a firm's success in leveraging digital marketing (DM) tools (Dave , Chaffey; Fiona , Ellis-Chadwick, 2019). It reflects the ability to transform digital presence and online interactions into tangible quantitative outcomes in global markets (Atshaya & Rungta , 2016), thereby serving as the economic output of e-marketing (EM) strategies (Katsikeas, Leonidou , & Zeriti, 2020).

2. Independent Variables

- **Website Visits:** A proxy for digital visibility and promotional effectiveness (Agusta & Yusnidar, 2024), representing the firm's reach to potential international customers (Dave & Fiona, 2022).
- **Online Orders:** The number of transactions completed through digital platforms (World , 2022), illustrating the conversion of digital engagement into actual export activities (P, Kotler; H, Kartajaya; I, Setiawan, 2021).

- **Foreign Customer Acquisition:** The firm's ability to attract new clients beyond national borders, serving as a direct measure of international market penetration (Chaffey, Ellis-Chadwick, Mayer, & Johnston, 2009).
- **Geographic Market Expansion:** The number of new countries or regions accessed through e-marketing strategies (Meyer, Li, & Brouthers, 2023), highlighting the strategic dimension of global diffusion (Wanying , 2025).
- **Total Shipment Costs:** Average logistical expenses incurred in delivering goods to international markets (World , 2022), representing a critical determinant of economic feasibility and competitive pricing (Obeidat, 2021).
- **Customer Satisfaction Rate (Complaint Count):** A measure of service quality and relational sustainability (Mattos, Casais, & Braga, 2021), conceptually valuable as a supportive variable rather than a direct determinant of export volumes (Keith D, Liang, Sali , & Noman , 2022).

These variables operate within an interconnected digital ecosystem. Website visits act as the entry point for potential transactions (Dave & Fiona, 2022), which materialize through online orders (P, Kotler; H, Kartajaya; I, Setiawan, 2021). Foreign customer acquisition and geographic market expansion embody the strategic dimensions of international growth (Meyer, Li, & Brouthers, 2023), demonstrating the firm's ability to penetrate new territories via digital tools. Shipment costs (World , 2022), however, remain a decisive economic factor that conditions the sustainability of such expansion. Meanwhile, customer satisfaction contributes to the accumulation of relational capital, even if its direct statistical influence on export volumes is limited (Mattos, Casais, & Braga, 2021).

This framework underscores that (EMI) constitute a strategic and integrated system that collectively fosters sustainable export growth and institutional competitiveness. by focusing on these variables, scholars and practitioners can gain deeper insights into how digital tools interact with economic and logistical factors to shape the trajectory of international expansion.

III. EMPIRICAL ANALYSIS:

This study measures the impact of e-marketing indicators (EMI) on the export development of the Algerian cement industrial group, employing diverse data collection tools to ensure comprehensive and reliable analysis.

1. **Face-to-face interviews:** Conducted with marketing and export managers in industrial firms to obtain in-depth qualitative insights into digital practices and export challenges.
2. **Direct observation:** Used to monitor marketing and logistical activities within firms, allowing the researcher to capture actual behaviors beyond formal statements.
3. **Archival and commercial documents:** Including invoices, export contracts, and official records, which provided accurate quantitative data on export volumes and international transactions.
4. **SEMrush tool for website performance analysis:** Applied to assess traffic, keywords, and SEO indicators, reflecting the effectiveness of firms' digital presence in international markets.

This methodological diversity demonstrates scientific rigor and enhances the credibility of the findings by combining both quantitative and qualitative evidence.

Presentation of Study Indicators Related to the Case of the Algerian Cement (GICA)

Within the empirical framework, the study presents the key quantitative indicators related to both independent and dependent variables for the case of the Algerian Cement Industrial Group (GICA) during the period 2018-Q1 to 2024-Q2, (see appendix no. 01)[1]:

- **Independent Variables:** Website visits (X1); International online orders (X2); Foreign customer acquisition (X3); New markets (geographic expansion (X4)); Total logistical costs (X5); Customer satisfaction rates (complaint count (X6)).
- **dependent variable** is defined as: Export Volumes via Online Opportunities (EXPO).

[1]**The columns (y, x2, x3, x4, x5, x6)** were prepared and calculated by the researcher based on interview outputs. **Column (x1)** was computed by the researcher using the outputs of SEMrush Analytics, specifically related to website performance analysis. Detailed monthly data are available at the following link: SEMrush Overview.
Rows highlighted in pink represent the pandemic period, starting from December 2019, reaching its peak, and then transitioning into the adaptation phase to the new reality, followed by recovery coinciding with the end of 2021.

The dataset will be utilized as input in the statistical analysis software EViews-10 to examine the impact of independent variables on the dependent variable. The statistical outcomes, together with their interpretation, will be presented in the subsequent Analysis and Results section. This will provide the basis for formulating practical strategies aimed at strengthening and advancing the export operations of the GICA industrial complex.

Descriptive Statistics of Study Variables:

This section reports descriptive statistics of the study variables using mean, median, minimum, maximum, and standard deviation. The analysis provides an initial overview of independent and dependent variables, forming a solid basis for advanced econometric modeling (see appendix no. 02).

1. The descriptive statistics indicate that the average quarterly export volume was 0.37 million tons, with a median of 0.35 million tons, reflecting balanced data distribution. The maximum value of 0.815 million tons was observed in Q3-2022, while the standard deviation of 0.23 suggests moderate fluctuations. Overall, GICA's export performance appears relatively stable, with certain quarters exceeding the average.
2. The descriptive statistics of the independent variables related to e-marketing indicators (EMI) can be summarized as follows:

Table (02): descriptive statistics of independent variable indicators.

x1	Website Visits: the average reached 2732, with a peak of 4,789 in Q1-2022 and a low of 1550 in Q1-2018, reflecting steady growth in the group's digital presence over the study period.
x2	International Online Orders: the average was 10.15, with a peak of 17 in Q2-2024 and a minimum of 1 in Q1-2018, indicating a consistent upward trajectory in online transactions throughout the study period.
x3	Foreign Customers: the average stood at 5.65, with a peak of 14 in Q2-2024 and a minimum of 0 in q1-2018, reflecting a steady and sustained expansion of the international customer base over the study period.
x4	International Markets (Geographic Expansion): Expansion ranged from 0 to 7 new markets, with an average of 3.38, underscoring steady geographic diversification and progressive international outreach.
x5	Total Logistical Costs: the average amounted to 14.05 thousand dzd per ton, peaking at 14.4 in Q3-2020 and declining to a minimum of 13.6 in Q2-2024, reflecting effective cost reduction and improved logistical efficiency in recent years.
x6	Customer Satisfaction (Complaint Count): the analysis shows an average of 0.42 complaints, with a maximum of 2 recorded during the early periods (2018–2019). in contrast, most subsequent quarters reported zero complaints, reflecting a marked improvement in customer satisfaction, particularly in the latter half of the study period.

Source: Prepared by the researchers based on **appendix no. 02.**

Overall, the indicators show that GICA has enhanced its digital presence, boosted international orders, entered new markets, lowered costs, and improved customer satisfaction, confirming the positive role of e-marketing in supporting exports.

Unit Root Test and Variable Stationarity:

In this study, unit root tests were conducted on both independent and dependent variables to verify their stability and eliminate random trends that could bias the analysis. Establishing the degree of stationarity is essential for ensuring data reliability, reinforcing the validity of conclusions, and enabling the application of robust econometric models to explain the relationship between (EMI) and export development. (see appendix no. 03), Using the **Dickey-Fuller GLS (ERS Test)**, considered an improved version of the **ADF Test** suitable for small samples, the computed values were compared with tabulated ones to assess time-series stationarity. At the level form, variables such as **EXPO, X1, and X2** showed stability under certain specifications (with constant or trend), rejecting the unit root hypothesis at $\mathbf{p < 0.05}$. However, variables **X3, X4, X5, and X6** exhibited high p-values (0.83–0.86), indicating non-stationarity and the presence of unit roots. At the first difference, all variables became stationary ($\mathbf{p \leq 0.05}$) across test forms, implying they are **integrated of order one (I (1))**. Thus, most

series are non-stationary at level but achieve stability at first difference, supporting the use of **cointegration models** in subsequent analysis.

Cointegration Test – Long-Run Relationship Among Variables : After establishing that most variables are integrated of order one (I (1)), the Johansen Cointegration Test (1991) was employed to examine the existence of long-run relationships among them. This test, widely recognized for its robustness in multivariate time-series analysis, identifies the number of cointegrating vectors that capture stable long-term associations between the independent and dependent variables. Confirming cointegration provides the foundation for applying advanced econometric models, such as the Autoregressive Distributed Lag (ARDL) and the Vector Error Correction Model (VECM), thereby deepening the understanding of how e-marketing indicators (EMI) drive the export development of the Cement Industrial Group (GICA).

Johansen Cointegration Test – Trace and Maximum Eigenvalue Results: The Trace Test revealed that the computed statistic (224.58) exceeded the critical value (125.61) at the 5% level, confirming one cointegrating relationship. Similarly, the second hypothesis produced a statistic (138.2) greater than the tabulated value (95.75), supporting a second cointegrating vector (see appendix no. 04). In contrast, the third hypothesis was not significant, as the computed value (33.75) fell below the critical threshold (33.87). The Maximum Eigenvalue Test further validated that only the first two vectors satisfied the significance criterion ($p < 0.05$). Taken together, both tests consistently indicate the presence of two cointegrating relationships, establishing a long-run equilibrium and justifying the application of cointegration-based regression models.

Correlation Coefficients Among Study Variables: Correlation coefficients are fundamental statistical tools used to measure the nature of relationships between variables (Dong, , He, & Blut, 2024), Correlation analysis was conducted to assess the direction—positive or negative—and the strength of associations between the dependent variable (export volumes via online opportunities) and the independent variables. This preliminary analysis provides essential insights into the interconnections among indicators and serves as a foundation for subsequent advanced econometric techniques, including multiple regression and cointegration models.

Correlation analysis between EXPO and the independent variables reveals positive associations for the first four indicators (website visits, online orders, foreign customers, and geographic expansion), with coefficients ranging from 0.5 to 0.6, indicating moderate to strong relationships. The strongest correlation was with international online orders (0.64). In contrast, shipping costs (−0.58) and customer complaints (−0.31) showed negative correlations, suggesting that higher costs or complaints diminish export performance (see appendix no. 05).

Correlation among independent variables was acceptable for X1 but exceeded 0.5 for X2, X3, and X4, suggesting potential multicollinearity. Coefficients ≥ 0.5 are generally viewed as evidence of linear overlap. To assess this further, the Variance Inflation Factor (VIF) was applied, which quantifies the inflation of variance in regression estimates due to multicollinearity. Higher VIF values indicate greater bias and inflated standard errors.

Multicollinearity Among Study Variables:

Multicollinearity occurs when independent variables in a regression model are highly correlated, inflating standard errors and reducing the reliability of coefficient estimates. This makes it difficult to isolate the individual effect of each variable, thereby undermining the accuracy of the model and the validity of analytical conclusions.

Researchers generally consider VIF values above 5 as evidence of multicollinearity. In this study, VIF values for x1 (1.56), x2 (3.32), x5 (2.74), and x6 (1.38) were below the threshold, indicating no issues. However, higher values for x3 (7.2) and x4 (5.21)—foreign customers and international markets—suggest strong correlations with other variables, potentially compromising model accuracy. To ensure reliable results, simple regression models are preferable, analyzing each independent variable separately with the dependent variable (see appendix no. 06).

IV. HYPOTHESES TESTING AND DISCUSSION:

Hypothesis testing and discussion are central to scientific research, providing a systematic means of evaluating proposed relationships using statistical data. The process distinguishes between

the null hypothesis (H_0), which assumes no effect, and the alternative hypothesis (H_1), which assumes a significant effect. Acceptance or rejection of H_0 depends on test results and the chosen significance level. The subsequent discussion interprets findings, links them to the theoretical framework, and highlights practical implications. This stage not only validates or refutes hypotheses but also identifies influential variables and suggests directions for future research.

Through data analysis and statistical testing of null hypotheses, the validity of relationships among study variables was assessed, enabling decisions that support the research objectives.

❖ **H_{01}: There is no statistically significant effect of website visits on the development of export volumes through online export opportunities at the 5% significance level (α= 0.05)**.

Refer to table (A), model 01, which presents the simple regression coefficients for the independent variable website visits. simple regression analysis of website visits on export quantities yielded a positive coefficient (0.000147), indicating a direct relationship. the probability value (0.0029) is below α= 0.05, confirming statistical significance. practically, each additional website visitor corresponds to an increase of about 147 tons in exports. website visits explained 31.4% of the variance, an acceptable level for a single predictor. the fisher test (F= 1.98, Sig= 0.003) further validated the model, supporting the first hypothesis and underscoring the role of online engagement in enhancing export performance.

➢ This result leads to the rejection of the first null hypothesis and acceptance of the alternative, confirming a statistically significant effect of website visits on the development of export quantities through online opportunities. To further confirm the robustness of the first model, it is necessary to verify that residuals follow a normal distribution and exhibit no heteroscedasticity. this verification is demonstrated through subsequent diagnostic tests.

Based on figure (A), model 01, which illustrates the residuals' distribution, the jarque–bera test yielded a value of 4.82 with a probability of 0.089, exceeding α = 0.05. this result confirms that the residuals follow a normal distribution, thereby supporting the validity of the model's statistical assumptions.

➢ **Heteroskedasticity Test for Model 1:** in regression analysis, constant residual variance is a key assumption. heteroskedasticity occurs when variance changes with predicted values, reducing estimator efficiency and weakening statistical inferences. table (B) reports the heteroskedasticity test results for model 1.

The results of the breusch–pagan test indicate that the residuals of the model do not suffer from heteroskedasticity, as the probability value of the test exceeds the significance level (0.05). this finding suggests that the variance remains constant across the predicted values, thereby supporting the adequacy of the statistical model and the reliability of its estimates.

➢ **Predictive power of Model 1:** After validating the regression model, it was employed to forecast export volumes via online opportunities up to Q2-2026. this predictive capacity is a key component of data analysis, as the model's results estimate future values and assess export performance trends based on available quantitative indicators.

Figure (B) illustrates the predictive capacity of model 1. Theil's coefficient (0.06) is close to zero, while the variance proportion (VP = 0.104) is negligible and the covariance proportion (CP) absent. these indicators confirm the model's reliability and strong forecasting power. in the long run, increased website visits are associated with sustained growth in export volumes through online opportunities (blue curve). this highlights the strategic importance of website visitors, as converting them into loyal customers enhances export growth and fosters interactive relationships. by prioritizing visitor acquisition and user experience, the industrial complex can better leverage global opportunities.

❖ **H_{02}: There is no statistically significant effect of online orders on the development of export volumes through available online export opportunities at the 5% significance level.**

Refer to table (A), model 02, which reports the simple regression results for online orders. the estimated coefficient (0.038746) is positive, indicating a direct relationship with export volumes. the probability value (0.0004) is below α = 0.05, confirming statistical significance. Practically, each additional online order corresponds to an increase of about 0.038746 million tons (≈ 38746 tons) in

exports. The model explains 41.03% of the variance, an acceptable level for a single predictor. the fisher test (F = 16.69, Sig = 0.0004) further validates the model, supporting the second hypothesis and highlighting the role of online transactions in strengthening export performance.

- The results lead to the rejection of the null hypothesis (H02) and acceptance of the alternative, confirming that Online Orders significantly affect export volumes through online opportunities. To validate Model 2, diagnostic tests verify that residuals follow a normal distribution and show no heteroskedasticity. Figure (A) illustrates this distribution, with the Jarque–Bera test (value = 1.174; probability = 0.559 > α = 0.05) confirming normality and reinforcing the model's validity.
- **Heteroskedasticity Test for Model 2:** In regression analysis, the assumption of constant residual variance is fundamental to ensuring reliable estimation. Heteroskedasticity arises when the variance of residuals changes with predicted values, thereby reducing estimator efficiency and weakening the validity of statistical inferences. table (B) reports the heteroskedasticity test results for model 2, providing evidence on whether this assumption holds in the current analysis.

  The results indicate that the residuals do not suffer from heteroskedasticity Breusch–Pagan Test Results, as the test probability value exceeds the significance level (α= 0.05). this confirms the constancy of residual variance across predicted values, thereby supporting the adequacy of the model and the validity of its statistical inferences.
- **Predictive Capacity of Model 2:** after validating the regression model, it was applied to forecast export volumes through online opportunities up to Q2-2026. This predictive function is a key element of data analysis, as the model's results provide future estimates and support informed decision-making.

  Figure (B) illustrates the predictive capacity of model 2. Theil's coefficient (0.13) is closer to zero than to one, the variance proportion (VP = 0.2) is negligible, and the covariance proportion (CP) is null. Together, these indicators confirm the model's strong predictive ability and reliability. In the long run, increased online orders are associated with sustained growth in export volumes through online opportunities (blue curve), where the coefficient rises over time. These findings underscore the strategic importance of online orders in expanding international market access, improving customer experience, and reducing costs. With evolving purchasing behavior and technological advancement, online orders will remain a key driver of growth and global competitiveness.

❖ **H_{03}: There is no effect of the number of international customers on the development of export volumes through available online export opportunities at the 5% significance level.**

Refer to table (A), model 03, which reports the simple regression results for international customers. the estimated coefficient (0.03325) is positive, indicating a direct relationship with export volumes. the probability value (0.0087) is below α = 0.05, confirming statistical significance. practically, each additional international customer corresponds to an increase of about 0.03325 million tons (≈ 33250 tons) in exports. the model explains 25.36% of the variance, an acceptable level for a single predictor. the fisher test (F = 8.158, Sig = 0.0087) further validates the model, supporting the third hypothesis and highlighting the role of international customers in enhancing export performance.

- Based on the results, the null hypothesis (H_{03}) is rejected and the alternative hypothesis is accepted, confirming that international customers exert a statistically significant effect on the development of export volumes through online export opportunities.
- to further confirm the accuracy of model 3, it is necessary to verify that residuals follow a normal distribution and exhibit no heteroskedasticity. this step is fundamental to ensuring the reliability of the results and the robustness of statistical inferences, as demonstrated by the subsequent diagnostic tests.
- **Normal Distribution of Residuals in Model 3:** within the simple regression framework, the normal distribution of residuals is a fundamental assumption for model validity. when residuals are normally distributed, the model is considered appropriate for statistical analysis, enabling the use of distributional properties to assess prediction accuracy and verify probability values, thereby enhancing reliability. Figure (A) illustrates the normal distribution of the residuals of model 3.

- As illustrated in the figure above, the jarque–bera test yielded a value of (3.174) with a probability of (0.204), which is greater than the significance level (α= 0.05). this outcome indicates that the residuals of model 3 conform to the normality assumption, thereby reinforcing the validity of the model and confirming its adequacy for statistical analysis.
- Refer to table (B), model 3, which reports the breusch–pagan test results. the findings indicate that the residuals do not exhibit heteroskedasticity, as the probability value exceeds the 5% significance level (α = 0.05). this confirms the constancy of residual variance across predicted values, thereby reinforcing the validity of the model and supporting the reliability of statistical inferences.
- **Predictive Capacity of Model 3:** after validating the regression model, it was applied to forecast export volumes via online opportunities up to Q2-2026. this predictive function represents a critical component of data analysis, as the model's results provide future estimates and support evidence-based decision-making.

  As shown in figure (B), which illustrates the predictive capacity of model 3, Theil's coefficient (0.13) is closer to zero than to one, the variance proportion (VP = 0.36) is relatively small, and the covariance proportion (CP) is null. taken together, these indicators confirm the model's strong predictive ability and reliability. in the long run, an increase in international customers is associated with a sustained rise in export volumes via online opportunities (blue curve). the coefficient may even double across successive periods, underscoring how expanding the customer base strengthens the complex's ability to capitalize on electronic opportunities, secure a strong position in international markets, and effectively meet global demand.

❖ **H_{04}: There is no effect of geographical expansion on the development of export volumes through available online export opportunities at the significance level (α= 0.05).**

  Refer to table (A), model 04, which reports the simple regression results for geographical expansion (international markets). the estimated coefficient (0.0757) is positive, indicating a direct relationship with export volumes. the probability value (0.0016) is below α = 0.05, confirming statistical significance. practically, entry into one new international market corresponds to an increase of about (≈ 75796 tons) in exports. the model explains 34.46% of the variance, an acceptable level for a single predictor. the fisher test (f = 12.62, sig = 0.0016) further validates the model, underscoring the role of geographical expansion in strengthening export performance.

- Based on the results, the null hypothesis (H_{04}) is rejected and the alternative hypothesis is accepted, confirming that new international markets (geographical expansion) exert a statistically significant effect on the sustainable development of export volumes through online export opportunities.
- **To further validate the accuracy of Model 4,** it is essential to verify that the residuals follow a normal distribution and do not suffer from heteroskedasticity. This step is fundamental to ensuring the reliability of the results and the robustness of statistical inferences, as demonstrated by the subsequent diagnostic tests.
- **Normal Distribution of Residuals in Model 4:** within the simple regression framework, the normal distribution of residuals is a fundamental assumption for model validity. when residuals conform to normality, the model is deemed appropriate for statistical analysis, enabling the use of distributional properties to assess prediction accuracy and verify probability values, thereby enhancing the reliability of the results. Refer to figure (A), which illustrates the normal distribution of the residuals of model 4. the jarque–bera test yielded a value of 3.51 with a probability of 0.1722, exceeding the 5% significance level (α = 0.05). this outcome indicates that the residuals of model 4 conform to normality, thereby reinforcing the validity of the model and confirming its adequacy for statistical analysis.
- **Heteroskedasticity Test for Model 4:** in regression analysis, the heteroskedasticity test is employed to verify whether residual variance remains constant. variance instability across predicted values can undermine result accuracy and weaken statistical inferences. ensuring constant variance confirms the reliability of model 4. refer to table (B) for the test results.
- **Breusch–Pagan Test Results:** the findings indicate that the residuals do not exhibit heteroskedasticity, as the probability value exceeds the 5% significance level (α = 0.05). this confirms

the constancy of residual variance across predicted values, thereby reinforcing the validity of model 4 and supporting the reliability of statistical inferences.

- **Predictive Capacity of Model 4:** after validating the regression model, it was applied to forecast export volumes through online opportunities up to Q2-2026. this predictive function constitutes a critical component of data analysis, as the model's results provide future estimates and support sustainable, evidence-based decision-making.

Figure (B) illustrates the predictive capacity of model 4. Theil's coefficient (0.16) is closer to zero than to one, the variance proportion (VP = 0.017) is negligible, and the covariance proportion (CP) is null. collectively, these indicators confirm the strong predictive ability and reliability of the model. in the long run, expansion into new international markets is associated with a sustainable rise in export volumes through online opportunities (blue curve). the coefficient may even double across successive periods, underscoring the strategic importance of geographical expansion in accessing new markets, broadening the customer base, facilitating product internationalization, and reducing dependence on a single market—thereby mitigating risks linked to economic or political fluctuations in specific regions.

- **H05: There is no effect of total shipment costs on the development of export volumes through available online export opportunities at the significance level (α= 0.05).**

Refer to table (A), model 05, which reports the simple regression results for total shipment costs. the estimated coefficient (-0.536) is negative, indicating an inverse relationship between shipment costs and export volumes. The probability value (0.0019) is below α = 0.05, confirming statistical significance. Practically, an increase of 1,000 DZD in shipment costs corresponds to a reduction of approximately 0.536 million tons (≈ 536076 tons) in exports. the model explains 33.73% of the variance, an acceptable level for a single predictor. the fisher test (F = 12.21, Sig = 0.0018) further validates the model, underscoring the significant impact of shipment costs on export performance.

- The results of the simple regression lead to the rejection of the null hypothesis (H05) and acceptance of the alternative, confirming a statistically significant negative effect of total shipment costs on export volumes through online opportunities. this indicates that higher shipping expenses substantially reduce export volumes, highlighting the need to control such costs to strengthen international competitiveness. to ensure the accuracy of model 5, it is necessary to verify that residuals follow a normal distribution and exhibit no heteroskedasticity. this diagnostic step confirms model adequacy and enhances the reliability of the results, as demonstrated by the subsequent tests.
- **Normal Distribution of Residuals in Model 5:** within the simple regression framework, the normal distribution of residuals is a fundamental assumption for model validity. when residuals conform to normality, the model is considered appropriate for statistical analysis, enabling the use of distributional properties to assess prediction accuracy and verify probability values, thereby enhancing the reliability of the results. refer to figure (A), Which illustrates the normal distribution of the residuals of model 5. jarque–bera test results: As shown in the figure, the Jarque–Bera statistic was 2.79 with a probability of 0.246, exceeding the 5% significance level (α = 0.05). this confirms that the residuals follow a normal distribution, thereby reinforcing the validity of model 5 and confirming its adequacy for statistical analysis.
- **Heteroskedasticity Test for Model 5:** the heteroskedasticity test assesses whether residual variance remains constant across predicted values, as variance instability may compromise accuracy and weaken statistical inferences. table (B) confirms the adequacy and reliability of model 5. breusch–pagan test results: the findings indicate that the residuals do not exhibit heteroskedasticity, since the probability value exceeded the 5% significance level (α = 0.05). this confirms that residual variance is constant across predicted values, thereby reinforcing the validity of model 5 and its suitability for statistical analysis.
- **Predictive Capacity of Model 5:** after validating the simple regression model through diagnostic tests, it was applied to forecast export volumes through online opportunities up to Q2-2026. this predictive aspect represents a crucial component of data analysis, as the model's results provide future estimates, reveal expected trends, and support strategic decisions on international market expansion

and competitiveness enhancement. refer to figure (B), which illustrates the predictive capacity of model 5. Theil's coefficient (0.15) is closer to zero than to one, the variance proportion (VP=0.0001) is negligible, and the covariance proportion (CP) is null. these indicators collectively confirm the strong predictive ability of the model. in the long run, higher shipment costs are associated with a sustained decline in export volumes (blue curve). conversely, reducing shipment costs enhances global competitiveness, opens new opportunities for export growth, and mitigates economic barriers to entering new markets—thereby supporting sustainable growth and ensuring success.

- **H06: There is no effect of satisfaction rates (represented by complaints filed against the complex) on the development of export volumes through available online export opportunities at the significance level (α= 0.05).**

Refer to table (A): simple regression coefficients for the independent variable "satisfaction rates". results of the simple regression for variable 6 (Complaints) show that the estimated coefficient (-0.117271) is negative, indicating an inverse relationship between complaints and export volumes.

however, the probability value (0.1128) exceeds the 5% significance level (α = 0.05), suggesting that the variable is not statistically significant. Accordingly, complaints do not exert a meaningful effect on export volumes. the t-statistic (-1.645972) further reflects the weak explanatory power of the model, as its absolute value falls below the conventional threshold (≤ 2). this absence of significance may be attributed to the limited number of observations (26) or the predominance of zero values, which reduces variability in the data. the constant term (C = 0.428461 million tons) represents the baseline level of export volumes in the absence of complaints. its highly significant t-statistic (p = 0.0000) confirms that the constant term plays a crucial role in the model, serving as a reliable baseline for forecasting export volumes. this reinforces the notion that other satisfaction-related variables exert a clearer and more significant influence on export development.

- The results of the simple regression lead to the rejection of the null hypothesis (H05) and acceptance of the alternative, confirming a statistically significant negative effect of total shipment costs on export volumes through online opportunities. This indicates that higher shipping expenses substantially reduce export volumes, highlighting the need to control such costs to strengthen international competitiveness. To ensure the accuracy of Model 5, it is necessary to verify that residuals follow a normal distribution and exhibit no heteroskedasticity. This diagnostic step confirms model adequacy and enhances the reliability of the results, as demonstrated by the subsequent tests.
- **Normal Distribution of Residuals in Model 6:** within the simple regression framework, the normal distribution of residuals is a fundamental assumption for model validity. when residuals conform to normality, the model is deemed appropriate for statistical analysis, enabling the use of distributional properties to assess prediction accuracy and verify probability values, thereby enhancing the reliability of the results. refer to figure (A), which illustrates the normal distribution of residuals in model 6.

jarque–bera test results: as shown in the figure, the jarque–bera statistic was 0.494 with a probability of 0.781, exceeding the 5% significance level (α = 0.05). This confirms that the residuals follow a normal distribution, thereby reinforcing the validity of model 6 and confirming its adequacy for statistical analysis.

- **Heteroskedasticity Test for Model 6:** Verifying homoscedasticity is essential in regression analysis to ensure model validity. Heteroskedasticity, where residual variance changes with predicted values, may compromise accuracy and weaken statistical inferences. the heteroskedasticity test applied to model 6 confirms its adequacy for analysis and forecasting; see table (B). breusch–pagan test results: the findings indicate that the residuals do not exhibit heteroskedasticity, as the probability value exceeded the 5% significance level (α = 0.05). this confirms that residual variance remains constant across predicted values, thereby reinforcing the validity of model 6 and its suitability for statistical analysis and forecasting.
- **Predictive Capacity of Model 6:** After validating the regression model through diagnostic tests (normality of residuals and homoscedasticity), the model was applied to forecast export volumes through online opportunities up to Q2-2026. this predictive dimension is a crucial component of data analysis, as it enables the estimation of future values, the assessment of expected trends, and the

support of strategic decision-making in the field of exports. although the theil coefficient was estimated at 0.02, the variance proportion (VP) and covariance proportion (CP) were not calculated due to the lack of statistical significance of the independent variable. this outcome indicates the absence of a meaningful statistical effect of complaints on export volumes through online opportunities. moreover, the predicted model exhibits considerable fluctuations in the curve over the long term, reflecting the limited accuracy in determining the effect and confirming the restricted explanatory power of model 6 regarding the relationship between complaints and export volumes.

- **H07: There is no effect of adopting e-marketing, through the combined indicators (website visits, international online orders, international customers, international markets, shipment costs, satisfaction rates), on the development of export volumes through online export opportunities by the industrial complex GICA, at the significance level (α= 0.05).**
- **Methodology for Testing Main Hypothesis 07:** the **Anova F-Test** was first employed to assess the overall significance of the regression model. this test evaluates whether the independent variables combined—namely website visits, international online orders, international customers, international markets, shipment costs, and satisfaction rates—exert a significant effect on the dependent variable, export volumes through online opportunities. subsequently, partial t-tests were applied to examine the statistical significance of each independent variable individually, thereby identifying those that contribute most to explaining the variance in export volumes. refer to table (A): anova f-test results for model 7. the probability value was less than the adopted significance level ($\alpha = 0.05$), indicating that the model is statistically significant as a whole. this confirms that the independent variables combined exert a meaningful and measurable effect on export volumes through online opportunities.
- **Wald Test for Model 7:** The Wald test was applied to assess hypotheses regarding the regression parameters. It evaluates whether the independent variables—website visits, international online orders, international customers, international markets, shipment costs, and satisfaction rates—have a statistically significant impact on export volumes through online opportunities. Complementing the ANOVA F-Test, the Wald test highlights the individual significance of each predictor, thereby identifying the most influential variables in explaining variance. See Table (B) for detailed results of the Wald test for Model 7.
- **Significance Test Results for Model 7:** The results of Fisher's F-test show that the calculated value (F-ca) exceeds the tabulated value (F-tab) i.e., (F-tab < F-ca), and the probability value is below the adopted significance level ($\alpha = 0.05$). this confirms that the regression model is statistically significant as a whole, and that the independent variables jointly exert a meaningful effect on the dependent variable, export volumes through online opportunities.

  The Wald test results show a probability value of 0.00, below the 0.05 threshold, leading to rejection of the null hypothesis of identical coefficients and acceptance of the alternative. This confirms that the study's coefficients are valid and significantly different from zero. In other words, all e-marketing indicators—website visits, international online orders, international customers, international markets, shipment costs, and satisfaction rates—collectively explain variations in export volumes through online opportunities. This provides strong statistical evidence that the independent variables exert a significant and non-random effect on the dependent variable.
- **Based on the statistical test results (F-test and Wald Test),** the null hypothesis is rejected and the alternative hypothesis is accepted. This confirms the existence of a statistically significant joint effect of e-**marketing adoption**—through the combined indicators of website visits, international online orders, international customers, international markets, shipment costs, and satisfaction rates—on the sustainable development of **export volumes via online export opportunities**. These findings highlight the effective role of e-marketing in supporting export activities and strengthening the competitive capacity of the GICA industrial complex in international markets.
- **Normal Distribution of Residuals in Multiple Regression:** Normality of residuals is a key assumption in multiple regression, ensuring model adequacy and reliable parameter estimates. Figure (A) shows the Jarque–Bera test value of 3.307 with a probability of 0.191, exceeding $\alpha = 0.05$. This confirms that residuals are normally distributed, reinforcing the validity of the regression model and

its suitability for statistical analysis. The normality assumption thus supports accurate predictions and reliable probability assessments.

- **Heteroskedasticity Test in Multiple Regression:** The heteroskedasticity test is a key diagnostic procedure in regression analysis, designed to verify whether the variance of residuals remains constant across predicted values. When heteroskedasticity is present, residual variance changes with predicted values, potentially compromising the accuracy of statistical estimates and weakening the reliability of conclusions. Conversely, when the assumption of homoscedasticity holds, the model is considered valid and appropriate for statistical analysis, ensuring more precise estimates and more reliable results. refer to table (C): heteroskedasticity test results in the multiple regression model. Breusch–Pagan Test results: the results show that the probability value exceeds the adopted significance level ($\alpha = 0.05$). This indicates that the residuals do not suffer from heteroskedasticity, meaning their variance remains constant across predicted values.

  Consequently, the multiple regression model is validated, and the statistical estimates and conclusions derived from it are considered accurate and reliable.
- **Predictive Capacity of the General E-Marketing Indicator:** After validating the multiple regression model through diagnostic tests (normality, homoscedasticity, and independence of residuals), the model was applied to forecast export volumes via online opportunities up to Q2 2026. This predictive dimension is essential for estimating future values, assessing trends, and evaluating the sustainability of e-marketing's impact on export development. Theil's coefficient (0.16), low variance proportion (VP = 0.043), and null covariance proportion (CP = 0.000) confirm the model's validity for forecasting. Figure (B) illustrates the forecast, where the blue line (EXPO) indicates a gradual yet statistically significant improvement in performance, reflecting the effectiveness of e-marketing strategies and the growing international demand for the GICA brand.
- **Confidence Interval Analysis for Model 7 Predictions:** The red dashed lines (±2 S.E) represent the upper and lower bounds of the forecasts, serving as an indicator of confidence in the model's predictions. When these bounds are close to the blue line (EXPO), it reflects a higher level of trust in the forecasts. However, the widening gap between the blue line and the red bounds after **Q3-2025** suggests potential variability in the predictions, even though the overall trend remains positive. Wide confidence intervals indicate a degree of uncertainty that may be influenced by external factors not captured in the model. Hence, continuous monitoring of indicators is essential to detect any further changes in direction. This underscores the critical role of independent variables in sustainably enhancing export volumes through online opportunities.

V. DISCUSSION

The econometric results led to the rejection of the null hypotheses and acceptance of the alternative ones, indicating statistically significant effects of e-marketing indicators (EMI) on the development of export volumes through digital export opportunities:

1. The null hypothesis ($H_{0.1}$) was rejected and the alternative hypothesis ($H_{1.1}$) accepted, indicating a statistically significant effect of website visits on the development of exported quantities through electronic export opportunities. Each additional website visitor leads to a sustainable increase of 147 tons in exported quantities, assuming other variables remain constant.
2. The null hypothesis ($H_{0.2}$) was rejected and the alternative hypothesis ($H_{1.2}$) accepted, indicating a statistically significant effect of electronic orders on the development of exported quantities through electronic export opportunities. Each additional order results in a sustainable increase of 46387 tons in exported quantities, assuming other variables remain constant.
3. The null hypothesis ($H_{0.3}$) was rejected and the alternative hypothesis ($H_{1.3}$) accepted, indicating a statistically significant effect of international clients on the development of exported quantities. Each additional international client leads to a sustainable increase of 33250 tons in exported quantities, assuming other variables remain constant.
4. The null hypothesis ($H_{0.4}$) was rejected and the alternative hypothesis ($H_{1.4}$) accepted, indicating a statistically significant effect of geographic expansion on the development of exported quantities through electronic export opportunities. Each entry into a new international market leads to a

sustainable increase of 75796 tons in exported quantities, assuming other variables remain constant.

5. The null hypothesis ($H_{0.5}$) was rejected and the alternative hypothesis ($H_{1.5}$) accepted, indicating a statistically significant negative effect of shipping costs on the development of exported quantities. Each increase in shipping costs by one-unit (1,000 DZD/ton) results in a sustainable decrease of 536076 tons in exported quantities, assuming other variables remain constant.
6. The null hypothesis ($H_{0.6}$) was accepted, indicating no significant effect of satisfaction rate (measured by the number of complaints) on exported quantities through electronic export opportunities, due to the insignificance of the relationship between the two variables.
7. The null hypothesis ($H_{0.7}$) (the main hypothesis) was rejected and the alternative hypothesis ($H_{1.7}$) accepted, indicating a significant effect at the significance level ($\alpha = 0.05$) of adopting the independent variable (combined indicators) on the development of exported quantities through the electronic export opportunities available to the group in a sustainable manner. The deviation of the independent variable coefficients from the zero value was able to explain the variations in exported quantities through electronic export opportunities, assuming other variables remain constant. This confirms the importance of investing in the development of these indicators to accelerate growth in the targeted markets.

VI. STUDY RESULTS:

The study results concluded with a set of econometric indicators confirming statistically significant relationships between e-marketing tools and exported quantities, reinforcing the importance of investing in digitalization as a strategic lever for international trade expansion:

1. The analysis reveals a positive effect of website visits on export volumes, underscoring the effectiveness of GICA's digital marketing in converting online awareness into purchase decisions. This finding highlights the strategic role of digital presence in facilitating B2B transactions, achieved through attractive content and interactive engagement with importers, thereby contributing to the sustainable growth of exported quantities.
2. The findings confirm a positive effect of electronic orders on export volumes. The steady growth in order numbers reflects the effectiveness of GICA's marketing strategy and the provision of accurate product information. Strengthening two-way interaction—through initiatives such as special offers that encourage purchase completion—demonstrates GICA's commitment to production quality aligned with international standards. These practices enhance the company's reputation in foreign markets and contribute to generating Requests for Quotation (RFQs).
3. The results emphasize the strategic importance of attracting international clients and their positive effect on export volumes. The progression from product awareness to purchase completion underscores the need to understand digital market dynamics. Strengthening online presence and fostering two-way interaction in B2B markets are therefore essential. This highlights the necessity of modern, targeted marketing strategies aimed at sustainable customer acquisition and long-term growth in exported quantities.
4. The results confirm the positive impact of geographic expansion on the sustainable growth of export volumes. Entering multiple markets as part of a comprehensive strategy not only mitigates reliance on a single international market but also creates opportunities to reach new clients and broaden business scope. Geographic diversification thus reflects a deeper understanding of the cultural, economic, and legal specificities of targeted markets, reinforcing long-term competitiveness.
5. The study identifies a negative relationship between shipping costs and export volumes, underscoring the adverse effect of high logistics expenses on price competitiveness and international demand. Elevated costs limit the exploitation of export opportunities, highlighting the need for strategies that reduce expenses and enhance logistical efficiency. Such measures are essential to ensure sustainable growth and strengthen GICA's position in B2B markets.
6. The study reveals that the satisfaction rate variable lacks statistical significance, underscoring its limited explanatory power for export volumes. Any potential influence appears to be mediated by

other factors—such as customer retention, return rates, shipping speed, service quality, referral activity, brand engagement, and purchase frequency—none of which are captured by the "complaints filed" indicator. Accordingly, strategies should focus on enhancing customer experience, integrating feedback and evaluations, and fostering engagement with prior purchasing interactions. These measures pave the way for developing an effective customer service system that supports data-driven decision-making and strengthens long-term competitiveness.

7. The results demonstrate that the independent variables collectively exert a complementary influence in strengthening the effectiveness of (EM) strategies for exports. The deviation of their coefficients from zero confirms that all indicators significantly explain variations in export volumes through electronic opportunities, reflecting a stable and sustainable relationship among the study variables. This finding underscores the potential for market expansion and outreach, while positioning electronic sales as a strategic complement to traditional and international sales alongside domestic ones.

Consistency with Prior Studies

- The empirical results of this study confirm that e-marketing indicators (EMI) collectively exert a statistically significant effect on export volumes through online opportunities. This finding is consistent with (Dong, , He, & Blut, 2024), who demonstrated that digitalization enhances export performance, though they emphasized contextual variation. Our study extends their conclusions by statistically validating specific e-marketing indicators within the heavy industry context of Algeria's cement sector.
- Similarly, the results align with **Heidarizad et al. (2024)**, who found that e-commerce supports export growth but did not disaggregate indicators. By breaking down the indicators, our study provides more granular evidence that each dimension of e-marketing (EM) contributes to export development.
- The positive joint effect of e-marketing (EM) adoption resonates with (Erum, Rafique, & Ali, 2017), who reported similar findings in the SME context of Pakistan. However, our study advances this line of research by applying the analysis to a large industrial complex (GICA), demonstrating that the relationship holds beyond SMEs.
- The predictive capacity of the model, showing gradual improvement in export volumes up to Q2-2026, complements (Wanying , 2025), who highlighted the role of digital marketing in brand internationalization. Our study bridges branding outcomes with measurable export growth.
- Finally, the statistical significance established at $\alpha = 0.05$ through ANOVA and Wald tests strengthens the empirical foundation compared to (Jyoti & Bijay Prasad , 2024), who argued for the importance of digital marketing in trade success but did not test indicator-level significance.

Theoretical Implications

The findings of this study carry several theoretical implications. From the perspective of the **Resource-Based View (RBV)**, e-marketing indicators (EMI) operate as strategic resources that strengthen competitiveness and improve export performance. Within the lens of **Internationalization Theory**, the gradual increase in export volumes reflects incremental internationalization processes facilitated by e-marketing adoption. Finally, through the **Dynamic Capabilities Framework**, the results underscore GICA's ability to continuously adapt its marketing strategies to evolving global conditions, thereby reinforcing sustainability in export growth.

Contribution to the Research Gap

By statistically validating the joint effect of disaggregated (EMI) and demonstrating their predictive capacity over time, this study directly addresses the identified research gap. it extends prior evidence from SMES and service sectors to heavy industry, showing that digital marketing (DM) adoption is both significant and sustainable in fostering export growth.

VII. CONCLUSIONOF THE STUDY:

Export e-marketing strategies, anchored in multi-channel digital tools, constitute a transformative paradigm within international trade. They provide Algerian enterprises with export capacity a strategic avenue to diversify the national economy beyond hydrocarbons, aligning with global competitiveness imperatives. The integration of advanced digital platforms—ranging from

website traffic optimization to international online ordering systems—facilitates the expansion of client bases and the penetration of new geographic markets. This digital orientation not only complements traditional export mechanisms but also enhances resilience by embedding agility and adaptability into corporate strategies.

The empirical findings of this study underscore the statistically significant role of (EMI) in shaping sustainable export growth. Website visits, international customers, shipment costs, and satisfaction rates emerge as critical determinants, collectively exerting a measurable impact on export volumes. The rejection of null hypotheses across multiple regression models validates the robustness of these relationships, while diagnostic tests confirm model adequacy through normality of residuals and absence of heteroskedasticity. Such methodological rigor strengthens the reliability of the conclusions and ensures their relevance for policy and practice.

Furthermore, predictive modeling extending to Q2-2026 demonstrates the capacity of e-marketing (EM) adoption to sustain gradual yet statistically significant improvements in export performance. The Theil coefficient and variance proportions confirm forecasting validity, highlighting the progressive enhancement of marketing strategies and the growing international demand for the GICA brand. This predictive dimension situates e-marketing not merely as a tactical instrument but as a strategic lever for long-term competitiveness.

From a managerial perspective, the study advocates for targeted advertising campaigns, value-added digital content, and continuous deployment of data analytics tools. These practices enable firms to maximize outreach, minimize performance gaps, and foster durable B2B relationships. Equally important is the strategic reduction of shipment costs, which directly influences competitiveness in price-sensitive markets. Geographic diversification, informed by cultural and regulatory considerations, further consolidates international presence.

In conclusion, e-marketing (EM) adoption represents a pivotal component of Algeria's national export strategy. By leveraging multi-channel tools, enhancing customer experience, and institutionalizing data-driven decision-making, Algerian enterprises—particularly the GICA industrial complex—can achieve sustainable export growth, strengthen brand awareness, and secure a resilient position in global markets.

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IX. APPENDICES

Comprehensive appendices, including detailed statistical tables and supplementary materials extending over 20 pages, are available through the following external repository link (Google Drive):https://drive.google.com/file/d/1uZLkA02N-Z27dctGx0aO6_himqM_1lbX/view?usp=sharing