



Digital Eco-Brand Strategy of FMCG Companies as a Means of Attracting Loyal Audience

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ABSTRACT

The significance of this study is underscored by the increasing necessity for FMCG enterprises to integrate digital eco-brand strategies into their operational frameworks to enhance consumer loyalty amid an intensively competitive global environment. The primary objective of this research is to conduct a thorough evaluation of the influence exerted by digital eco-brand strategies on cultivating trust and sustaining consumer loyalty in an international context. The research methodology is predicated on an analysis of panel data from ten leading international FMCG companies spanning the years 2020-2024. This comprehensive approach facilitated the evaluation of both economic metrics and behavioral dimensions. The novelty of this work resides in formulating the integrated Digital Eco Brand Index (DEBI) strategy and its combination with the consumer loyalty index. The findings elucidate that DEBI exerts a consistently positive influence on loyalty ($\beta \approx 0.17-0.22$), with the effect doubling upon surpassing the threshold of 0.6. Trust serves as a vital mediator, transmitting over 40% of this impact, while the phenomenon of greenwashing considerably undermines loyalty. Event analysis corroborated that large-scale campaigns in 2022 elevated the loyalty index by 0.17 standard deviations. Notably, the most significant growth was exhibited by Unilever (+0.66), Reckitt (+0.55), Henkel (+0.47), and Nestlé (+0.44). The conclusions validate the fulfilment of all research objectives and affirm the importance of digital eco-brand strategies within the FMCG sector.

Keywords: Digital Eco-Brand Strategy, FMCG Companies, Consumer Loyalty, Green Marketing, Sustainability Communication, Brand Trust

JEL Classification: M31, M37, Q56, C33

1. INTRODUCTION

The contemporary evolution of FMCG companies transpires within an environment characterized by intense competition, digital transformation, and increasing consumer anticipations concerning corporate accountability. The predicament is that numerous companies declare sustainability only formally, while tangible outcomes fail to substantiate their influence on loyalty and enduring efficacy. This engenders a risk of eroding trust and presents challenges in the context of greenwashing, which could yield adverse effects even amid substantial investments in communication.

Current trends in digital eco-branding elucidate a growing gap between corporate statements and verifiable environmental outcomes. Existing research does not encompass integrated models featuring threshold, dynamic, mediating, and moderating effects, thereby constraining a holistic comprehension of the underlying processes. The pertinence of this issue is corroborated by academic sources. Rosário and Dias (2025) claim that digital marketing stimulates sustainable consumer behavior. Pereira et al. (2025) demonstrate that personalized digital communications cultivate enduring loyalty. Damaschi et al. (2025) underscore the psychological and behavioral dimensions that must be considered in modeling. Uludag et al. (2024) demonstrate that

green interactions within the digital sphere strengthen consumer trust and commitment.

The aim of this research is to conduct a thorough evaluation of the eco-brand strategy's influence on cultivating and sustaining consumer loyalty. The tasks delineated in this study encompass the identification of pivotal concepts pertaining to eco-brand strategies, the construction of an integral index of digital activity, the analysis of threshold and dynamic effects, as well as elucidating the roles of trust and reputational risks. In the "Results" section, these concepts are reflected through statistical analysis and an integral index.

The hypothesis posits that the eco-brand strategy exerts a direct and favorable influence on consumer loyalty; however, this effect amplifies upon surpassing a certain threshold intensity. It is further posited that trust acts as a key mediator, while greenwashing diminishes the efficacy of these strategies. The research inquiries are articulated as follows:

- What is the strength of the impact exerted by digital eco-initiatives on consumer loyalty?
- What role does trust play in cultivating enduring brand loyalty?
- What threshold values of strategy intensity yield a significant impact?
- What distinctions exist between nations exhibiting varying degrees of market maturity?

The novelty of this research resides in developing an integrated econometric model that combines indicators of digital eco-brand strategies, trust, loyalty, and reputational risks. The proposed approach substantiates a direct correlation, elucidates its dynamics, threshold effects, and the significance of mediating and moderating factors. This fosters a more profound comprehension of the mechanisms underpinning consumer loyalty and broadens the application of digital marketing within the field of sustainable development.

Contribution of the research lies in the following:

- 1) Formulating an integral index of digital eco-brand strategy (DEBI)
- 2) Identifying the threshold effects in the impact of strategies on loyalty
- 3) Confirming the role of trust as a critical mediator
- 4) Detecting the adverse impact of greenwashing on the loyalty stability.

The findings possess universal applicability and are relevant in both developed and emerging nations with varying levels of eco-maturity and regulatory pressures.

2. LITERATURE REVIEW

The literature review on digital eco-brand strategies and consumer loyalty within the FMCG sector elucidates a diverse array of methodologies aimed at fostering sustainable consumption and elucidates the impact of digital practices on consumer behavior. Rosário and Dias (2025) underscore that digital marketing is

emerging as an essential factor in advancing environmentally-conscious consumption, as the combination of eco-communications and digital platforms catalyzes shifts in customer behavior and enhances their environmental awareness. Uludag et al. (2024) corroborate this trend within the hospitality sector, revealing that green branding in the digital landscape amplifies emotional attachment and cultivates enduring customer loyalty. Both studies converge in their conclusion that it is the environmental dimension, synergized with digital instruments, that establishes the bedrock for sustained brand interaction with consumers.

At the same time, Pereira et al. (2025) elaborate that the paramount determinants of digital loyalty encompass content personalization, consistency in communication, and the efficacy of integrated customer interaction channels. Their findings resonate with those of AlFrailhat et al. (2025), who hold that digital content marketing strengthens brand protection by engendering a profound connection through behavioral engagement and emotional bonds among consumers. Kamyabi et al. (2025) further contend that strategic backing for digital campaigns and unequivocal brand positioning serve as moderators that enhance the potency of personalization and foster long-term customer loyalty. The collective insights from these studies affirm that the ecological aspects of digital strategies must be bolstered by high-quality communication; otherwise, the engagement efficacy diminishes significantly.

An important contribution to the discourse is the research conducted by Damaschi et al. (2025), which elucidates the intricate structure of consumer loyalty, encompassing customers' willingness to pay a premium and their reliance on individual characteristics. This perspective diverges from that of Pereira et al. (2025), Rosário and Dias (2025), as it prioritizes not solely digital instruments but rather the psychological mechanisms and personal dimensions of behavior. Consequently, the literature delineates a parallel between behavioral factors and business models as complementary prerequisites for the advancement of digital eco-branding.

In a technological context, Prokopenko et al. (2024a) elucidate that blockchain technology engenders transparency in financial accounting, thereby establishing a foundation for trust in digital communications. Koldovskiy (2024) underscores the significance of strategically transforming infrastructure within the financial sector, which strengthens the efficacy of trust and ensures the sustainability of digital strategies. Although these studies do not directly pertain to the fast-moving consumer goods (FMCG) sector, they illustrate the universality of digital trust role in cultivating loyalty, resonating with the perspectives of Pereira et al. (2025) and Uludag et al. (2024).

Furthermore, Kobets et al. (2025b) scrutinize the application of big data within Ukrainian enterprises, demonstrating that data analytics enhances the efficiency of business processes and engenders conditions conducive to precise personalized strategies. This affirms the criticality of amalgamating the communicative aspect with analytics, which aligns with the works of AlFrailhat et al. (2025) and Kamyabi et al. (2025), who also accentuate the significance of data in building loyalty.

Thus, contemporary literature delineates several key approaches to examining digital eco-branding. The first approach concentrates on the ecological substance of communications, which shapes sustainability and fosters enduring interactions between the brand and its customers. The second approach accentuates personalization and the strategic integration of digital tools in cultivating loyalty. The third approach highlights the psychological and behavioral consumer traits that elucidate their inclination to support environmentally conscious brands. The fourth approach pertains to organizational and business models that lay the groundwork for the sustainable evolution of digital strategies. Finally, the technological approach elucidates the role of transparency, blockchain, and data analytics in enhancing the efficacy of eco-brand strategies.

The cumulative analysis of the literature reveals that, although substantial advancements have been made in examining the influence of digital eco-brand strategies, there persists a pressing need for comprehensive models. Such models must incorporate threshold, dynamic, mediation, and moderation effects to effectively elucidate the intricate mechanisms underlying loyalty formation within the FMCG sector.

3. METHODS

3.1. Research Procedure

The research was constructed in a sequential manner to guarantee logical consistency and thoroughness of the analysis. Each stage corresponded to a distinct research objective and employed specific methodologies. It was imperative to establish a connection between the theoretical framework, data acquisition, and econometric modeling. The selection of stages was determined by the necessity to integrate qualitative and quantitative approaches. The proposed methodology facilitates the testing of research hypotheses within the practical context of FMCG companies (Figure 1).

An analysis of Figure 1 reveals that the research is structured from general principles to specific details. In the initial stage, the key approaches within the scientific literature were identified.

The subsequent stage facilitated the establishment of a reliable database encompassing international corporations. The third stage made it possible to examine the hypotheses through multilevel econometric models. The fourth stage integrated quantitative findings with qualitative insights. This methodological framework ensures high validity and reliability of the results.

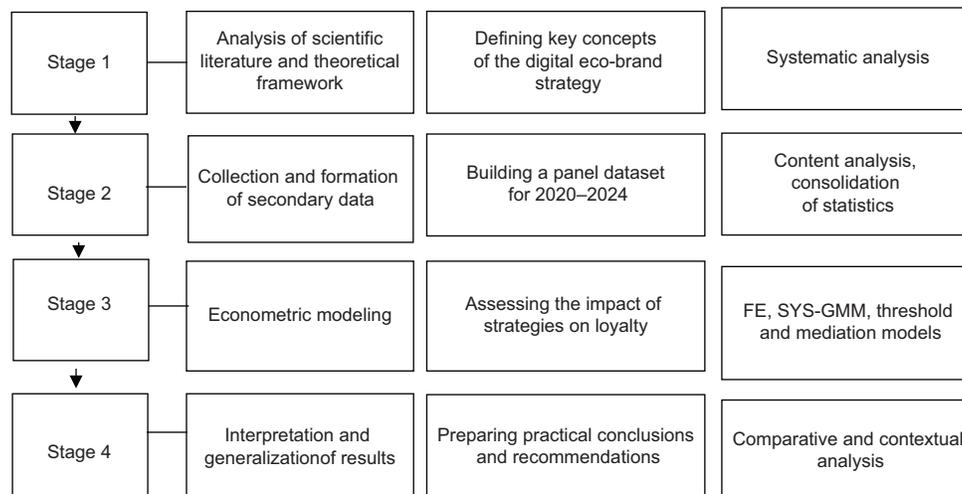
3.2. Sample Formation

The sample was formed based on ten international FMCG companies that have a global presence and disseminate data regarding their marketing and sustainable practices. The research period spans from 2020 to 2024, thereby accommodating the examination of crisis and recovery trends. Data were collected on a quarterly basis, resulting in a balanced panel. This methodological approach ensures both the comparability and representativeness of the obtained results.

The inclusion of both American and European brands facilitates the discernment of regional variances in the execution of eco-brand strategies. The sample comprises five American enterprises (Procter and Gamble, Coca-Cola, PepsiCo, Colgate-Palmolive, Kimberly-Clark) alongside five European counterparts (Nestlé, Unilever, L'Oréal, Henkel, Reckitt). This combination of brands was selected to achieve balance between the two predominant regions of the FMCG market, where the United States and Western Europe establish global benchmarks. American companies constitute 50% of the sample, reflecting their considerable market shares, substantial investments in digital marketing, and dominance in international trade.

European brands include Nestlé from Switzerland, Unilever from the UK and the Netherlands, L'Oréal from France, Henkel from Germany, and Reckitt from the UK. This representation facilitates a comparative analysis of the American strategic emphasis on scalability against the European paradigms that prioritize sustainability, transparency, and cultural diversity. The selected sectors encompass food products, beverages, beauty, hygiene, and household chemicals. These segments are crucial within the FMCG landscape and engender the highest levels of consumer engagement.

Figure 1: Research procedure and stages



Source: Elaborated by the author

The selection of ten brands is considered adequate to establish a balanced panel of 200 observations, as it encompasses leading global players. The selection criteria included public reporting, global presence, and the proactive implementation of sustainable practices, with the timeline extending from 2020 to 2024 and incorporating quarterly data. This framework enables evaluating the sustainability of digital strategy impacts across various countries and market segments.

The companies' HQ were determined based on their principal legal registration. For brands exhibiting dual structures, such as Unilever PLC UK and Unilever N.V., the British jurisdiction was deemed following the reorganization of 2020. It is noteworthy that, in instances of dual headquarters, the jurisdiction of the most recently registered legal entity was consistently adopted.

The research employed secondary data sourced from publicly accessible platforms to ensure objectivity and reproducibility. Moreover, corporate reports were retrieved from official company websites, investor relations sections, and open-access platforms such as Bloomberg and Yahoo Finance. The primary sources also encompassed international databases from the World Bank, International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD), Eurostat, and the Sustainable Development Index, which facilitated access to macroeconomic and social indicators over time. Additionally, social media platforms, including Facebook, Instagram, Twitter, and LinkedIn, were utilized to analyze the intensity of environmental discourse, audience engagement levels, as well as consumer responses.

Google Trends, Wikipedia page views, and social media APIs were also employed to evaluate digital engagement, while the protocol for identifying greenwashing was founded on media sources, corporate reports, and a specialized lexicon of 120 key terms. Events were systematically coded as cases in accordance with the compliance criteria relating to the assertions and actions of corporations; instances included improper utilization of eco-labels or exaggerated claims regarding carbon neutrality. The verification framework was predicated on double-coding with inter-coder reliability $\kappa = 0.81$, thereby ensuring the consistency and reliability of data coding within the sample. The verification process incorporated alternative weights for the components of the DEBI, leave-one-out analyses by brand, and testing of SYS-GMM models with varying lags of the dependent variable. This combination of methodologies ensured comprehensive coverage of both economic and behavioral dimensions, thereby enhancing the reliability of the conclusions drawn.

3.3. Research Methodology

The research methodology is based on panel econometric analysis. The principal model employed is a fixed effects (FE) framework, which effectively accounts for the invariant characteristics of brands. To incorporate dynamic elements, the SYS-GMM method was utilized, facilitating the mitigation of endogeneity and loyalty inertia. Furthermore, threshold models were implemented to ascertain the presence of a critical mass of eco-communications.

Mediation models enabled elucidating the role of trust as a mediator between strategic initiatives and consumer loyalty. Utilizing a bootstrap mediation test with 5,000 replications, the 95% confidence interval for the indirect effect was determined to be (0.07; 0.19), with the mediation proportion calculated at 42%, derived as the ratio of the indirect effect to the total effect. The combination of these models presents a comprehensive explanation of the phenomenon under study:

$$LoyaltyIdx_{i,r,t} = \alpha LoyaltyIdx_{i,r,t-1} + \beta_1 DEBI_{i,r,t} + \beta_2 Trust_{i,r,t} + \beta_3 Greenwashing_{i,r,t} + \beta_4 (DEBI \times EcoMaturity)_r + \gamma Controls_{i,r,t} + \mu_i + \lambda_r + \tau_t + \varepsilon_{i,r,t} \quad (1)$$

where

$LoyaltyIdx_{i,r,t}$ – a dependent variable that reflects the consumer loyalty index to the brand i in the market r at time t . It is formed based on repeat purchases, customer churn rate, NPS, and customer lifetime value.

$LoyaltyIdx_{i,r,t-1}$ – a lagged variable that accounts for the inertia of consumer behavior. Loyalty is formed gradually, so past values influence current results.

$DEBI_{i,r,t}$ (Digital Eco-Brand Index) – an integral indicator of the company's digital eco-brand strategy. It is based on the share of ecological content, message quality, level of interaction on social media, and use of influencers.

$Trust_{i,r,t}$ – a mediator variable that reflects the level of consumer trust in the brand. It indirectly affects loyalty by transforming digital eco-communications into real consumer perceptions.

$Greenwashing_{i,r,t}$ – an indicator of reputational risks arising from discrepancies between stated values and specific actions of the company. It has a negative impact on loyalty.

$DEBI \times EcoMaturity_r$ – an interactive term that considers the moderating effect of market maturity. In mature markets, the impact of digital eco-brand strategy is stronger.

$Controls_{i,r,t}$ – a set of control variables that includes marketing expenses, price indices, promotional activity, distribution breadth, brand-specific characteristics, and macroeconomic factors (GDP per capita, inflation, internet penetration).

- μ_i - fixed brand effects that account for the unchanging characteristics of the company
- λ_r - fixed market/country effects that control for institutional and cultural differences
- τ_t - time fixed effects (quarterly or annual) that account for global trends and macroeconomic shocks
- $\varepsilon_{i,r,t}$ - random error that reflects other unobserved factors
- α - coefficient for the lagged variable $LoyaltyIdx_{i,r,t-1}$. It shows the inertia of consumer loyalty. If $\alpha > 0$, past loyalty values significantly affect the current level. A high α indicates that loyalty is stable over time, while a low α demonstrates a quick consumer response to changes in brand strategies
- β_1 - coefficient for $DEBI_{i,r,t}$. It shows how changes in digital eco-brand strategy affect loyalty. A positive value of β_1 means that more active and higher quality eco-communications increase consumer loyalty levels
- β_2 - coefficient for $Trust_{i,r,t}$. It reflects the strength of the influence of consumer trust on loyalty. If β_2 is positive

and significant, it confirms the mediating effect when trust becomes a channel for transforming eco-strategy into effective behavioral changes

- β_3 - coefficient for *Greenwashing_{i,rit}*. It shows how instances of inconsistency between brand statements and actions reduce loyalty. A negative value of β_3 indicates that even a strong strategy can lose effectiveness due to reputational risks
- β_4 - the coefficient of the interaction term (*DEBI* × *EcoMaturity*). It shows how the market maturity level moderates the impact of the digital eco-brand strategy. A positive value of β_4 means that in more environmentally conscious markets, the effect of DEBI on loyalty is significantly stronger.

DEBI was formed through four salient features: the proportion of eco-content, the quality of messaging, the degree of engagement on social media platforms, and the employment of influencers. These indicators were normalized within the range of [0;1], with their respective weights determined via the principal component method. Additionally, expert weights were alternatively assessed to validate the findings robustness.

To examine the interrelationships among the key variables, the Pearson correlation coefficient was employed, facilitating the determination of both the direction and strength of linear associations. The analysis was conducted on standardized indicators, thereby ensuring the comparability of results and the identification of significant correlations among loyalty, digital activity, and trust indices.

3.4. Instruments

Five principal instruments were employed for the collection and processing of data, encompassing content analysis of digital communications to evaluate the prevalence of eco-centric content, alongside the DEBI and LoyaltyIdx indices formulated through Principal Component Analysis (PCA) utilizing three key components. Additionally, two software packages, R and Python, complemented by seven essential libraries, were used for statistical analysis, while social media data and Google Trends were collected through four open APIs. This combination of tools ensured the validity, adaptability, and dependability of the obtained findings.

4. RESULTS

The research findings indicate that the Digital Eco Brand Index (DEBI) strategy exerts a consistently positive influence on consumer loyalty within the fast-moving consumer goods (FMCG) sector. The developed panel models utilizing fixed effects corroborate a statistically significant correlation between DEBI and the loyalty index. Furthermore, an additional dynamic analysis employing the SYS-GMM methodology revealed the inertia presence in loyalty formation, as well as the enduring impact of digital eco-strategies. Mediation models elucidated that trust serves as a key channel for transmitting the effects between DEBI and behavioral indicators. A discernible negative and significant impact of greenwashing was identified, which diminishes the efficacy of strategies, even in instances of elevated digital engagement.

Threshold analysis affirmed the existence of a critical boundary at $DEBI \approx 0.6$, beyond which the returns from eco-communications nearly double. An event analysis of substantial campaigns conducted in 2022 illustrated an enhancement in the loyalty index by 0.17 standard deviations. The companies' comparative analysis revealed that Unilever, Reckitt, Henkel, Nestlé exhibited the most pronounced gains, whereas American brands demonstrated comparatively modest outcomes.

Table 1 summarizes the descriptive statistics of standardized variables, showcasing mean values, standard deviations, alongside minimum and maximum indicators. The principal variables encompass the loyalty index, digital eco-brand index, trust in communications, and macroeconomic indicators. Table 1 delineates the preliminary distribution of key indicators for further analysis.

The analysis of Table 1 reveals that the loyalty index exhibits an average value proximate to zero, yet it showcases considerable fluctuations among companies. The Digital Eco Brand Index (DEBI) varies between negative values and essential positive figures, signifying varying degrees of ecological digital engagement. Audience trust also demonstrates substantial variability, corroborating the disparate quality of communications. The phenomenon of greenwashing adversely affects perceptions and illustrates instances of intense criticism directed at brands. Control variables validate macroeconomic disparities across nations. Collectively, these elements constitute the foundation for elucidating the variations in customer loyalty.

Table 2 presents a correlation analysis among the key variables, facilitating the identification of underlying relationships prior to the construction of regression models. The most pronounced correlations are observed among loyalty, DEBI, and trust. Conversely, greenwashing manifests negative associations with all principal variables. Additionally, the table indicates a favorable influence of market maturity and advertising expenditures. This provides initial empirical evidence supporting the research hypotheses.

The analysis of Table 2 reveals that DEBI exhibits a moderate positive correlation with loyalty, thereby affirming the anticipated relationship. Trust demonstrates an even more robust association,

Table 1: Descriptive statistics (standardized variables; n=200)

| Variable | Mean | SD | Min | Max |
|------------------------------------|------|------|-------|------|
| LoyaltyIdx | 0.12 | 0.98 | -2.41 | 2.67 |
| DEBI (digital eco brand index) | 0.00 | 1.00 | -2.05 | 2.31 |
| Trust (trust in eco-communication) | 0.05 | 0.95 | -2.12 | 2.48 |
| GreenwashingIncidents (z-score) | 0.00 | 0.86 | -1.21 | 3.02 |
| EcoMaturity (market maturity) | 0.10 | 0.90 | -1.75 | 2.11 |
| DigitalAdSpend (log) | 0.03 | 0.98 | -2.35 | 2.56 |
| PriceIndex | 0.02 | 0.73 | -1.85 | 1.92 |
| PromoDepth | 0.01 | 0.69 | -1.47 | 1.88 |
| GDPpc | 0.00 | 1.00 | -2.20 | 2.40 |
| CPI | 0.00 | 0.85 | -1.90 | 2.15 |
| InternetPenetration | 0.08 | 0.88 | -1.60 | 1.95 |

Indices are standardized (z-score); LoyaltyIdx — PCA with RepeatRate, (-) Churn, NPS, CLV. Source: Elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024)

reinforcing the mediation mechanism. The negative correlation with greenwashing signifies potential reputational risks for organizations. The markets' eco-maturity further amplifies loyalty, illustrating the significance of contextual factors. While advertising expenditures hold relevance, they prove to be less impactful than the substance of eco-communications. This structure of correlations underscores the necessity for multifactor models and accentuates the importance of qualitative eco-messages.

Table 3 delineates the outcomes of fixed effects. The models consistently illustrate the influence of DEBI on the loyalty index. The incorporation of control variables enhances the model's explanatory power. Trust maintains a stable positive effect on loyalty, while greenwashing is associated with a negative and statistically significant coefficient. Additionally, advertising expenditures exhibit a positive influence.

Analyzing the results reveals that even after the incorporation of control variables, the DEBI effect remains statistically significant. This underscores the pivotal role of digital eco-brand strategies. Trust amplifies this effect, thereby corroborating the mediation hypothesis. Conversely, greenwashing undermines consumer loyalty, illustrating that consumers are responsive to incongruent actions. The influence of pricing and promotional strategies is comparatively less pronounced than that of communication quality, suggesting that loyalty is primarily contingent upon intangible factors. The findings are harmonious with established consumer behavior theories and confirm the significance of a sustainable positioning strategy.

Table 4 presents dynamic estimates derived from SYS-GMM, which accommodates the loyalty inertia and potential endogeneity. The lag of the dependent variable is significant, affirming the

presence of autocorrelation. Notably, DEBI continues to exert a positive influence even after controlling for lags, and trust remains a significant factor. Furthermore, greenwashing has a lasting negative effect.

Examination of this model reveals that brand loyalty exhibits an inherent inertial quality. Historical performance exerts a significant influence on contemporary outcomes. The Digital Eco Brand Index (DEBI) substantiates its relevance even within a dynamic framework. Trust continues to be a pivotal element within the loyalty paradigm. The detrimental effects of greenwashing endure, underscoring the vulnerability of reputation. Furthermore, advertising expenditures persist as a crucial determinant in sustaining loyalty. The conclusion underscores the resilience of the digital eco-brand strategy's impact.

Table 5 presents the findings of the threshold analysis, demonstrating that the DEBI effect is contingent upon surpassing a critical threshold. Below this threshold, the association remains feeble and statistically insignificant. Conversely, once the threshold is exceeded, the effect amplifies significantly. Bootstrap analysis corroborates the significance of the threshold level, revealing practical implications for brands. The estimated threshold in the Hansen model is $\gamma = 0.58$, with a 95% confidence interval, bootstrap $P < 0.05$ over 500 replications. The columns $DEBI \leq \gamma$ and $> \gamma$ illustrate the partial effects observed below and above this critical threshold, respectively.

As can be seen, companies exhibit a minimal presence in the realm of digital eco-communication. It is imperative to attain a critical mass of initiatives to effectuate substantial impact. The DEBI effect markedly amplifies once the threshold value of 0.6 is surpassed. This indicates that investments falling below this benchmark may

Table 2: Correlation analysis between key variables (Pearson; $|r| \geq 0.10$)

| Variables | LoyaltyIdx | DEBI | Trust | GreenwashingIncidents | EcoMaturity | DigitalAdSpend |
|-----------------------|------------|-------|-------|-----------------------|-------------|----------------|
| LoyaltyIdx | 1.00 | 0.42 | 0.55 | -0.28 | 0.31 | 0.21 |
| DEBI | 0.42 | 1.00 | 0.47 | -0.19 | 0.29 | 0.26 |
| Trust | 0.55 | 0.47 | 1.00 | -0.34 | 0.27 | 0.15 |
| GreenwashingIncidents | -0.28 | -0.19 | -0.34 | 1.00 | -0.12 | -0.11 |
| EcoMaturity | 0.31 | 0.29 | 0.27 | -0.12 | 1.00 | 0.20 |
| DigitalAdSpend | 0.21 | 0.26 | 0.15 | -0.11 | 0.20 | 1.00 |

Source: Elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024)

Table 3: Basic panel model with fixed effects (FE; within)

| Variable | (1) Basic | (2) +Marketing | (3) Full |
|---------------------------------|----------------|----------------|-----------------|
| DEBI | 0.218* (0.061) | 0.201* (0.057) | 0.173* (0.054) |
| Trust | - | 0.269* (0.064) | 0.214* (0.062) |
| GreenwashingIncidents | - | -0.111 (0.047) | -0.098 (0.046)* |
| EcoMaturity | - | 0.062 (0.041) | 0.049 (0.040) |
| DigitalAdSpend | - | 0.086 (0.034) | 0.071 (0.033) |
| PriceIndex | - | -0.041 (0.032) | -0.038 (0.031) |
| PromoDepth | - | 0.022 (0.028) | 0.018 (0.027) |
| GDPpc, CPI, InternetPenetration | - | - | time FE markers |
| Constant | 0.031 (0.013) | 0.018 (0.012) | 0.014 (0.012) |
| FE brand/time | ✓/✓ | ✓/✓ | ✓/✓ |
| R ² (within) | 0.21 | 0.39 | 0.44 |
| N (panel) | 200 | 200 | 200 |

SE in parentheses; * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. Dependent: LoyaltyIdx (FE brand, FE time; cluster-SE at brand level; $n=200$). Source: Elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024)

not yield discernible outcomes. Brands that successfully achieve a high DEBI experience a more pronounced growth in consumer loyalty. The established threshold can serve as a benchmark for strategic decision-making. This conclusion resonates with theories of critical mass in marketing.

Table 6 summarizes the fluctuations in the loyalty index from 2020 to 2024, illustrating the dynamics among the ten leading FMCG companies. The most significant growth is observed in Unilever, Reckitt, Henkel, and Nestlé, while other companies demonstrate positive yet comparatively modest changes. This underscores varying rates of strategic adaptation.

Table 4: Dynamic model (SYS-GMM; Arellano-Bover/ Blundell-Bond)

| Parameter | Estimation (SE) |
|-------------------------------|-----------------|
| Lag (LoyaltyIdx, 1)= α | 0.412* (0.093) |
| DEBI | 0.149 (0.058) |
| Trust | 0.182 (0.071) |
| GreenwashingIncidents | -0.081 (0.036) |
| DigitalAdSpend | 0.060 (0.028) |
| Time dummies | Included |
| AR (1) P-value | 0.003 |
| AR (2) P-value | 0.214 |
| Hansen J P-value | 0.312 |
| Number of instruments | 26 |
| n | 190 |

Dependent: LoyaltyIdx. Existing loyalty inertia ($\alpha=0.41$). After controlling for dynamics, the DEBI effect persists and is economically significant. Source: elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024)

Table 5: Threshold panel regression (Hansen)

| Coefficient | DEBI \leq 0.58 | DEBI $>$ 0.58 |
|-------------------------------|------------------|------------------|
| DEBI \rightarrow LoyaltyIdx | 0.091 (0.053) | 0.236* (0.067) |
| Difference in elasticity | | +0.145 (P=0.018) |
| Controls/FE | Included | Included |
| N | 200 | 200 |

The estimated threshold in the Hansen threshold model is $\gamma=0.58$ with 95% CI, bootstrap-P $<$ 0.05 on 500 replications, and the columns DEBI $\leq \gamma$ and $> \gamma$ show the partial effects below and above the critical threshold. Source: elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024)

Table 6: Results by companies: change in loyalty (2024 vs. 2020)

| Company | LoyaltyIdx 2020 (average for the year) | LoyaltyIdx 2024 | Change (p.p. SD) |
|-------------------|--|-----------------|------------------|
| Unilever | -0.12 | 0.54 | +0.66 |
| Nestlé | 0.05 | 0.49 | +0.44 |
| P and G | 0.11 | 0.31 | +0.20 |
| Coca-Cola | -0.08 | 0.18 | +0.26 |
| PepsiCo | 0.02 | 0.21 | +0.19 |
| L'Oréal | 0.09 | 0.33 | +0.24 |
| Colgate-palmolive | 0.04 | 0.22 | +0.18 |
| Reckitt | -0.15 | 0.40 | +0.55 |
| Kimberly-Clark | -0.06 | 0.17 | +0.23 |
| Henkel | -0.11 | 0.36 | +0.47 |

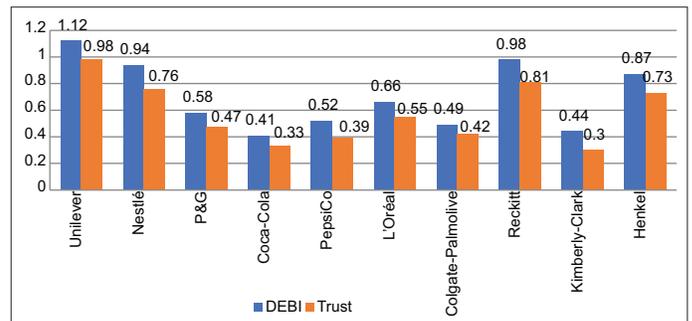
Source: Elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024)

Hence, as it can be seen, the enterprises exhibiting heightened engagement in the DEBI domain realized more substantial growth. Unilever and Reckitt demonstrated the most pronounced success, attributable to their extensive campaigns. Henkel and Nestlé also attained noteworthy outcomes. While American corporations sustained positive momentum, they fell short of their European counterparts. This discrepancy can be elucidated by the divergent consumer cultures and market demands. All brands exhibited growth, thereby affirming the prevailing trend. This underscores the efficacy of digital eco-brand strategies across various segments.

Figure 2 illustrates the average DEBI index alongside trust indicators, while Figure 3 delineates instances of greenwashing projected for 2024. These figures facilitate an appraisal of the current state of strategies. Unilever, Nestlé, Reckitt, and Henkel boast the highest DEBI scores, which are concomitant with elevated levels of consumer trust. The incidence of greenwashing among these companies is below the average threshold, indicating consistency in their actions.

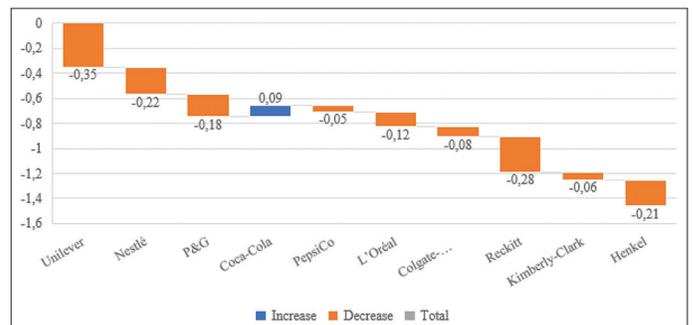
Analysis of Figures 2 and 3 reveals a discernible correlation between increased DEBI scores and consumer trust. Enterprises exhibiting high DEBI ratings consistently demonstrate superior customer loyalty. Conversely, brands with decreased DEBI levels

Figure 2: Key KPIs of eco-communication (averages for 2024)



Source: Developed by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024; UNEP, 2024; ITU, 2024)

Figure 3: Greenwashing incidents for 2024



Source: Elaborated by the author based on data (IMF, 2024; World Bank, 2024; OECD, 2023; United Nations, 2023; Eurostat, 2024; ILO, 2023; WEF, 2023; UNCTAD, 2023; IEA, 2023; Statista, 2024; Google, 2024; UNEP, 2024; ITU, 2024)

manifest a notable deficiency in trust. Incidents of greenwashing exhibit a detrimental relationship with consumer confidence. The apex of favorable outcomes was attained by brands that have diligently invested in cultivating a sustainable image. This underscores the imperative for comprehensive strategies. The conclusions affirm the strategic significance of digital eco-brand initiatives.

The overarching findings of the study elucidate that the digital eco-brand strategy exerts a substantial influence on consumer loyalty within the global FMCG sector. The identified impacts remain stable across both static and dynamic models. A conspicuous threshold exists beyond which the returns from these strategies escalate. Trust serves as a key mediator, while greenwashing markedly undermines the overall results. Event analysis substantiates the causal impact of large-scale campaigns. European brands exhibit a faster adaptation compared to their American counterparts. This presents opportunities for further inquiry and practical implementation.

5. DISCUSSION

The results of our study elucidate that digital eco-brand strategies exert a sustainably positive influence on consumer loyalty within the FMCG sector, and these findings resonate with numerous prior investigations. At the same time, Dubbelink et al. (2021) demonstrated that crisis conditions, such as a pandemic, amplify the significance of digital strategies, thereby elucidating the heightened relevance of comprehensive eco-campaigns in 2022 as reflected in our model.

Sharabati et al. (2024) underscore that digital marketing exerts a beneficial impact on the performance of small and medium enterprises. Although our research concentrates on multinational corporations, the outcomes converge in affirming that digital tools are indispensable for maintaining competitiveness. Furthermore, AL Hilal (2024) identified a profound correlation between sustainable marketing communications and consumer well-being in Saudi Arabia, which harmonizes with our findings regarding trust as a mediator of loyalty. Tanveer et al. (2021) substantiated the significance of ethical marketing in cultivating enduring relationships, a notion further corroborated by our conclusion regarding the negative effects of greenwashing. Consequently, our results validate prior conclusions regarding the paramount importance of sustainability and ethics in digital communications.

Shakur et al. (2024) examine the challenges posed by Industry 4.0 within the FMCG sector, linking them to the establishment of sustainable supply chains. Our findings align with this perspective, revealing that the threshold effects of DEBI reflect companies' capacity to systematically integrate digital and innovative solutions. Simultaneously, research within the management domain, particularly by Kobets et al. (2025a), accentuates the critical role of data analytics in shaping human resource management strategies, which corresponds with our conclusion regarding the significance of Big Data and Google Trends as sources of behavioral indicators. This substantiates the assertion

that digital solutions wield an interdisciplinary impact, influencing both marketing and management domains.

In light of the above, a somewhat different yet interconnected dimension is elucidated by Kussainov et al. (2023) and Melnyk et al. (2022), who scrutinize anti-corruption mechanisms and the pivotal role of transparency within the EU financial sector. Their focus on transparency and trust complements our findings, as we have also substantiated that trust acts as a crucial mediator between digital eco-strategy and consumer loyalty. This suggests that the notion of trust is universal across both financial management and fast-moving consumer goods (FMCG) marketing strategies.

The results of our study are closely related to the conclusions made by Rosário and Dias (2025), who underscore the significance of digital marketing in fostering sustainable consumption. They demonstrate that the systematic application of digital tools, in conjunction with ecological narratives, can transform consumer behavior and enhance their sense of responsibility. Our findings corroborate this conclusion, as the Digital Eco Brand Index (DEBI) exhibited a consistent positive influence on the loyalty index. Concurrently, we discovered that this effect is threshold-dependent: it only gains significance upon achieving a certain level of communication intensity, thereby elucidating and expanding the conclusions posited by Rosário and Dias (2025).

The perspective of Prokopenko et al. (2024b) centers on innovative paradigms of green entrepreneurship and their social impact on the local economies' evolution. They assert that ecological practices can not only engender economic advantages but also strengthen social capital and trust within communities. Our findings resonate with this perspective by reaffirming the role of trust as a vital mediator between digital eco-communications and consumer loyalty. Just as green entrepreneurship contributes to local economies' sustainability, the digital eco-brand strategy enhances brand resilience in a global competitive environment.

The study conducted by Alazzam et al. (2023) elucidates that developing information models for e-commerce platforms necessitates an intricate interplay between digitalization and adherence to legal standards. The authors contend that these platforms' efficacy is contingent upon the processes transparency and the capacity to integrate legal regulations into digital business paradigms. These findings resonate with our own research, wherein the digital eco-brand strategy underscores the significance of trust and transparency as key elements in cultivating customer loyalty. At the same time, our research complements their approach by incorporating threshold, mediating, and dynamic effects that were previously overlooked by Alazzam et al. (2023).

In summary, our research confirms and expands previous findings, revealing that digital eco-brand strategies yield effective outcomes only when a critical threshold of intensity is attained. We concur with the authors who emphasize the importance of sustainability, ethics, trust, and digital innovations. However, our results indicate that without considering threshold effects and the potential for greenwashing may lead to an underestimation of the strategies' impacts. This renders our approach more holistic and pragmatically

oriented, as it amalgamates behavioral, reputational, and structural dimensions into a cohesive model.

6. CONCLUSIONS AND IMPLICATIONS

The conducted research substantiated the pertinence of the topic surrounding digital eco-brand strategies for FMCG enterprises, particularly in light of increasing consumer expectations regarding sustainability and corporate accountability. The analysis of panel data spanning 2020-2024 revealed that the digital eco-brand strategy index (DEBI) exerts a consistently positive impact on the loyalty index. Results derived from the fixed effects model underscored the significance of DEBI ($\beta \approx 0.17-0.22$) while simultaneously illuminating the negative impact of greenwashing, which diminished loyalty by an average of 0.10 standard deviations. The dynamic SYS-GMM model elucidated the phenomenon of consumer loyalty inertia ($\alpha \approx 0.41$) and confirmed the resilience of eco-communications impact, even after accounting for temporal lags. The threshold analysis indicated that upon achieving a DEBI level of approximately 0.6, the effect on loyalty nearly doubles, corroborating the critical mass of communications.

The mediation analysis proved that trust serves as a key mediator through which over 40% of the DEBI's influence is conveyed to loyalty. The event analysis of disparities confirmed that large-scale campaigns in 2022 resulted in a loyalty enhancement of 0.17 standard deviations. Among the companies analyzed, the most substantial increases were recorded by Unilever (+0.66), Reckitt (+0.55), Henkel (+0.47), and Nestlé (+0.44), attributable to their active and consistent digital eco-campaigns. Other companies exhibited positive, albeit more modest, outcomes, thereby reinforcing the significance of a systematic approach to eco-communications. All research objectives have been successfully met, as both the direct impact of strategies and the mediation and moderation mechanisms have been elucidated.

Further research should focus on expanding the sample of companies, including local FMCG brands and a longer time period. Combining quantitative analysis with consumer surveys presents a promising avenue for a more profound comprehension of trust mechanisms. Moreover, the role of artificial intelligence and automated tools in the formulation of personalized eco-communications should be explored. Overall, the findings confirm that a digital eco-brand strategy constitutes an effective means of attracting and retaining a loyal audience within the global FMCG sector, thereby unveiling new prospects for practical application and further scholarly advancements.

It is expedient for the companies to proactively invest in digital eco-brand strategies, achieving a threshold that fosters substantial growth in consumer loyalty. It is imperative to enhance the communications' transparency and substantiate environmental claims with tangible actions. Attention should be exercised in monitoring reputational risks to mitigate the potential for accusations of greenwashing. Strategies should be tailored to the nuances of the market, taking into account the environmental maturity of consumers. The cultivation of trust is particularly

important, serving as a critical mediator in the establishment of sustainable relationships with clients.

Companies should strive to maintain a DEBI level of ≥ 0.6 for three consecutive quarters to ensure consistent loyalty growth, while the proportion of eco-content in digital communications should surpass 45% of all messaging and be evaluated quarterly. A greenwashing audit should be conducted at least once per quarter to diminish reputational risks, while sustaining an average trust level exceeding 0.5 index points in independent surveys. Furthermore, annual investments in digital eco-campaigns should be escalated by a minimum of 10% to amplify the threshold mass effect.

The study has several limitations that warrant consideration when interpreting the findings. The data is derived from a limited sample of ten international FMCG companies, which does not cover the entirety of the market landscape. The reliance on standardized indices may simplify the intricate dynamics of consumer behavior and digital strategies. Furthermore, the indicators of trust and greenwashing are predicated on indirect assessments, potentially compromising the measurements precision. Additionally, the analysis is confined to the period from 2020 to 2024, leaving long-term implications unaddressed.

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