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Empirical Evidence from the Bootstrap Rolling Window Approach on the Nexus between Agriculture Performance and the Environmental Kuznets Curve in China

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ABSTRACT:

This study employs the bootstrap Granger causality test and rolling window sub-sample to examine the relationship between agricultural output and CO2 emissions in China from 1990 to 2022. The rolling window method provides a more sophisticated analysis because it considers essential economic changes over time. Consequently, this is the first study to divide the sample periods into subsets and derive parameters from within each subset. During the first subset of data, which spans the years 1990 to 2004, the parameter for agricultural expansion has a tendency towards snowballing, according to the study's findings. However, the parameter for the second subgroup, which includes the years 2004 to 2022, exhibits a downward trend. These findings lend further credence to the notion that China possesses an EKC shaped like an inverted U.

Keywords: Agricultural Performance, Carbon Dioxide (CO2), Environmental Kuznets Curve

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Introduction

The agricultural sector in China has a long and significant history that spans over four thousand years. The Chinese farmers have developed and refined specialized crop cultivation and soil preservation techniques throughout this period. The industry has played a crucial role in facilitating economic growth and development at the national level, as it offers a wide array of raw materials and generates effective demand for various other sectors of the economy. The agricultural labor force holds considerable importance, constituting a major proportion of the workforce. The agriculture business in China satisfies crucial dietary requirements and enhances China's competitive position in the global trade landscape through direct and indirect import and export activities. China, an emerging economic giant boasting a population of over 1.4 billion, acknowledges the significance of the agricultural sector as a crucial component in fortifying the nation's underpinnings for sustained success. Chinese agriculture has assumed a pivotal position in facilitating the country's economic progress since the implementation of reforms in 1978. Particularly in recent years, when China's economic growth has decelerated, the agricultural sector has proven indispensable. China experienced a remarkable average yearly growth rate of 9.7 percent in its Gross Domestic Product (GDP) during the period spanning from 1978 to 2006. Despite the agricultural sector's current modest growth rate of 4.5% in comparison to the higher growth rates observed in the industry (11.6%) and services (10.3%), it is anticipated to persistently offer crucial support to the economy and contribute to a stable and substantial pace of economic expansion during the period of restructuring and opening. China plays a significant role in global food production, contributing 18% of the world's cereal grain output, 29% of global meat production, and an impressive 50% of worldwide vegetable production. As a result, China has emerged as the dominant agricultural economy on a global scale, surpassing other nations in terms of food production. The Chinese agriculture industry has achieved a notable accomplishment by effectively generating almost 20% of the global food supply despite possessing only a modest 9% share of the world's arable land. The significant agricultural output in China has important ecological effects, particularly in relation to carbon (CO2) emissions, which present a considerable negative. The present circumstances have given rise to apprehensions over the ecological ramifications of China's agricultural methods. Therefore, the current study aims to examine fundamental inquiries about pollution arising from China's agriculture industry. The primary aims of this research endeavor involve empirically estimating the Kuznets environmental curve (EKC) in the context of China and examining the association between agricultural performance in China and its influence on CO2 emissions. The focus is to determine whether this relationship exhibits a positive or negative effect. The present study expands upon prior research undertaken in this field, which included noteworthy contributions made by Cole et al. (1997). Their findings provided empirical evidence for the substantial impact of agricultural practices on greenhouse gas emissions. Furthermore, Janzen (2004) conducted a study demonstrating a positive association between worldwide agricultural practices and carbon dioxide (CO2) release. Janzen attributed this connection to burning plant remnants and soil debris, which are substantial sources of emissions. Furthermore, Bhatia et al. (2013) provided evidence to support the notion that using inorganic fertilizers can potentially lead to

releasing N2O emissions. Similarly, Zhang and colleagues (2015) emphasized the impact of agricultural waste burning on the increase of CO2 emissions. Additionally, the study conducted by Mohamad et al. (2016) made a significant addition by providing insights into the detrimental consequences of manure utilization, highlighting its negative impact on the net carbon flux. The current study aims to thoroughly understand the environmental consequences of agricultural practices in China, specifically focusing on carbon dioxide (CO2) emissions. By examining the relationship between agricultural performance and environmental contamination, this study aims to enhance our understanding of the challenges facing China's agricultural sector and provide policymakers with valuable insights for addressing these challenges effectively. The agricultural sector encompasses numerous economic facets, including economic expansion, employment creation, and food production. Nonetheless, the extent of its impact on the environment is primarily unknown. Notably, several scholars argue that a variety of agricultural activities, including the use of machinery and equipment, transportation, electrical lighting, heating and cooling of agricultural buildings, increased demand for raw materials, pesticide use, land utilization, and chemical application, all contribute to energy consumption and greenhouse gas emissions. In fact, agriculture has the potential to produce positive environmental outcomes by nurturing a variety of organic life forms and increasing the tropospheric oxygen content. Emissions of greenhouse gases are only one of several environmental effects that agricultural research has examined. For instance, studies conducted in China demonstrate that the use of fertilizers, herbicides, and mechanization in agriculture are the most significant contributors to pollution due to their effect on greenhouse gas emissions. In other studies, scientists have examined the pattern of China's agricultural CO2 emissions and proposed various methods for mitigating emission-based situations in various regions. In addition, some studies have found a significant relationship between agricultural economic growth and CO2 emissions. Others have calculated regional nitrogen and phosphorus emissions from agriculture and proposed mitigation strategies. Nonetheless, some researchers have analyzed the characteristics of agricultural CH4 and N2O emissions and advocated for a substantial reduction in per capita emissions in the world's largest nations. This study employed the Bootstrap Rolling Window (BSRW) technique to evaluate the EKC in China regarding agricultural performance, with the overarching objective of contributing to the growing body of research aimed at disproving the EKC theory. This analysis is unique because it employs the BSRW to evaluate the relationship between agriculture and CO2 emissions. The implications of the EKC for China's agricultural sector are investigated, as is the relationship between agricultural activities and carbon dioxide emissions. The introduction of the research paper provides an overview of the theoretical framework that underpins the study. This is followed by further sections that go into the methodology employed, the obtained results, and a comprehensive discussion of the findings. The research closes by presenting a section encompassing the study's findings and providing recommendations. This study contributes to the existing academic literature by comprehensively evaluating the Environmental Kuznets Curve (EKC) hypothesis. Moreover, it offers significant insights for ecologists, policymakers, and scholars by employing a distinctive approach to examine the relationship between agricultural and carbon dioxide (CO2) emissions.

Methodology

The BSRW Model is used in this study to achieve the study's goal. This study applies a more rigorous model to obtain more solid and trustworthy results and improve the analysis's prediction power. Scholars, academicians, and researchers have included various parameters in the model over time to address econometrics concerns and omitted variables. Furthermore, as researchers have used more complex estimation approaches, econometric estimating methods have evolved with the inclusion of numerous variables in the model. Therefore, the study includes a comprehensive presentation of various research variables and econometrics approaches chronologically to provide a thorough understanding of the subject at hand. The negative association between trade openness is revealed by the Johansen Fisher Panel Co-integration Test, as indicated by Zhang et al. (2017) and Jebli et al. (2016). Similarly, capital and labor were added to the model, and the heterogeneous panel cointegration test was conducted. Apergis and Payne (2009) discovered positive connections between capital and labor. The Generalized Method of Moments (GMM) analysis of energy consumption by Chakravarty and Mandal (2016) reveals a positive impact. Dogan and Turkekul (2016) measured the utilization of renewable energy using the Autoregressive Distributed Lag (ARDL) model and discovered weakly adverse to negative relationships. According to Jalil and Feridun (2011), De Vita et al. (2015), Munir and Ameer (2018), Zhang and Gao (2016), and other studies employing the ARDL method, the financial, industrial, commercial, and tourism development sectors all have a positive impact on the dependent variable. The results of your and Lv's (2018) examination of globalization using geographical correlations reveal a complex pattern of negative and positive connections. Utilizing the Multiple Linear Regression Model (MLRM), Li et al. (2012) found comparable results when studying agriculture. These empirical findings cast light on the strength and direction of the variable relationships, laying the groundwork for future research and informing policy decisions. Previous studies have investigated the Environmental Kuznets Curve (EKC) using econometric models. These studies have focused on analyzing carbon dioxide (CO2) emissions as the dependent variable while considering actual gross domestic product (GDP) and the square of real GDP as explanatory factors. Nevertheless, it is important to acknowledge that these models are constructed upon several flawed assumptions. These include considering both positive and negative parameters for real GDP and real GDP squared, as they assume an inverse U-shaped correlation between economic growth and environmental degradation. Additionally, these models assume that the computed parameters accurately represent the entire sample. This study aims to re-assess the relationship between agricultural productivity and carbon dioxide (CO2) emissions in China from 1990 to 2022. The study employs the BSRW approach, which enables the calculation of the influence of agricultural performance on CO2 emissions during specific subsampling periods. Utilizing features acquired from each subsampling interval enhances the dependability of validating the authenticity of the Environmental Kuznets Curve (EKC) assumption. In contrast to previous research, this one uses a BSRW technique to evaluate the correlation between agricultural output and pollution levels, a BSRW causality approach to identify potential shifts in the causal relationship between agriculture and pollution and a multi-stage sample design to isolate the effects of agriculture on pollution levels. The study also

uses Hacker and Hatemi-(2006) example of complete causal nexus and Toda Yamamoto's (1995) entire sampling method to analyze the causal relationship between variables, independent of their integration. In addition, the study utilizes Efron's (1979) start test approach to determine essential test values. As a result, the first stage of this strategy involves examining the vector autoregression procedure.

Y_t=γ_0+γ_1 Y_(t-1)+⋯+γp Y_(t-p)+εt,t=1,2,…,T (1)

Where p shows the lag order of the equation while 〖 εt is a random error with zero mean and constant variance and covariance; however, Yt is alienated into three vectors.

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \gamma_{10} \\ \gamma_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{10}(L) & \gamma_{10}(L) \\ \gamma_{20}(L) & \gamma_{20}(L) \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (2)$$

whereas γij (L)=∑_(k-1)^p 〖γ_(ij,k) L^k,i,j=1,2 and L〗 is the lag.

The null hypothesis for equation (2) posits that there is no causal relationship between agricultural performance and CO2 levels, and this can be determined by setting the coefficients γ_(12,i) to zero for I = 1,2,…,p, and assuming no confounding factors. Nonetheless, the null hypothesis posits that there is no Granger-causal relationship between CO2 and agricultural performance.

$$Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \cdots + \gamma_p Y_{t-p} + \varepsilon_t, t = 1,2, \dots, T \quad (1)$$

Where p shows the lag order of the equation while 〖 ε_t is a random error with zero mean and constant variance and covariance. However, Y_t is alienated into three vectors.

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \gamma_{10} \\ \gamma_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{10}(L) & \gamma_{10}(L) \\ \gamma_{20}(L) & \gamma_{20}(L) \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (2)$$

By putting zero constraints _(21,i)=0 for i=1,2,....,p. In empirical investigations, researchers use a variety of methodologies to discover underlying structural alterations. Nonetheless, the rolling window causality technique of Balcilar et al. (2010) is used in this research to account for changes in the cause-and-effect interactions between the agricultural sector and pollution over time. Balcilar et al. (2010) developed a causality strategy using Hacker and Hatemi-(2006) J's prior technique to study the link between bootstrap causality in rolling window subsamples.

$$.t = \tau - 1 + l, \tau - 1, \dots, \tau, \tau = l, l + 1, \dots, T,$$

Where "l" represents a rolling window. Furthermore, the p-values associated with the LR statistics are determined by the calculation of T-1 subtests. This indicates that the expected changes in the causal relationship between agriculture and CO2 emissions remain consistent. Furthermore, the impact of agriculture on pollution is quantified as $B^{-1}\sum_{k-1}^{p}\hat{\gamma}_{21,k}^{*}$ with$\hat{\gamma}_{21,k}^{*}$. The readjusted number is the vector auto-regressive (VAR) model estimate using equations 2 and B. Likewise, the impact of environmental pollution on agriculture is calculated as $B^{-1}\sum_{k-1}^{p}\hat{\gamma}_{21,k}^{*}$ where $\hat{\gamma}_{21,k}^{*}$ is attained from bootstrap appraisal VAR model by 2 and B refers to bootstrap the reset number. The revised value corresponds to the estimation of the vector autoregressive (VAR) model using equations 2 and B. Similarly, the assessment of the influence of environmental pollution on agriculture is determined by the formula $B^{-1}\sum_{k-1}^{p}\hat{\gamma}_{21,k}^{*}$ where $\hat{\gamma}_{21,k}^{*}$ derived from the bootstrap estimation of a VAR model with a lag order of 2, and B represents the number of bootstrap replications.

The increasing awareness among customers regarding enterprises' societal and environmental

impacts has led to a heightened focus on corporate social responsibility (CSR) in recent times. In addition to legal requirements, Corporate Social Responsibility (CSR) encompasses the proactive efforts of organizations to enhance their social and environmental performance. Digital marketing is a strategy firms employ to promote their corporate social responsibility (CSR) initiatives (Anderdal et al., 2023). It is imperative to explore novel tactics to enhance the influence of corporate social responsibility (CSR) messages, given the ongoing discussion surrounding the effectiveness of CSR communication via digital marketing. One method that can be employed is artification, which entails incorporating aesthetic elements into corporate social responsibility (CSR) messages to enhance audience engagement and attractiveness. The present study aims to investigate the efficacy of artification in digital marketing for corporate social responsibility (CSR), with a particular emphasis on the moderating influence of brand authenticity. According to De Sordi et al. (2022),

Research Problems and Questions

This study aims to investigate the research challenges about the efficacy of artification in digital marketing for corporate social responsibility (CSR) and the impact of brand authenticity on this connection. The subsequent research inquiries structure the inquiry:

1- What is the impact of artification in digital marketing on the effectiveness of corporate social responsibility (CSR) messaging?

2- To what extent does the impact of artification on the effectiveness of corporate social responsibility (CSR) initiatives become influenced by the degree of brand authenticity?

3- What is the impact of demographic characteristics, such as age, gender, educational attainment, and job position, on managers' judgments of artification in digital marketing for corporate social responsibility (CSR)?

Research Objectives and Hypotheses

The main objective of this study is to find out how well artification works in digital marketing for CSR, focusing on the role of brand credibility as a moderator. The following hypotheses are developed to help with this:

H1. The impact of CSR messages is improved by using digital marketing.

H2: The relationship between artification and CSR effectiveness is moderated by brand authenticity. When brand authenticity is strong, the positive effect of artification on CSR effectiveness is amplified.

H3: Age, gender, level of education, and job rank are among the demographic factors that affect the relationship between artification and the effectiveness of CSR.

Scope and Limitations of this study

The present study, conducted at the United Bank of Pakistan in Karachi, sought to investigate the potential moderating influences of brand authenticity and demographic characteristics on the relationship. Additionally, the study attempted to examine the impact of artifice in digital marketing on the effectiveness of corporate social responsibility (CSR) messaging. The objective of this study was to provide insights that can assist firms in enhancing their corporate image and amplifying the effectiveness of their corporate social responsibility (CSR) messaging. When interpreting the findings, it is crucial to consider the study's limitations. The limited scope of the study, which focused exclusively on the United Bank of Pakistan, may restrict the generalizability of the findings to other contexts. The statistical power of the analysis may be impeded by a second constraint, namely the limited sample size of the study, which focused exclusively on one company, the United Bank of Pakistan. Consequently, the generalizability of the findings

to other contexts may be limited. Furthermore, the study employed participant-reported data, potentially introducing bias due to the influence of social desirability. Finally, the cross-sectional methodology employed in the study precludes the ability to establish causal links between the variables.

Literature Review

Porter's general strategies

Porter's general strategies framework is extensively employed in the corporate realm to analyze competitive advantage. The three overarching techniques for achieving a competitive advantage, as posited by famous Harvard Business School professor Michael Porter, are cost leadership, differentiation, and focus. Cost leadership is a strategic approach firms employ to attain a competitive advantage over their rivals by minimizing production and operational expenses (Deng et al., 2022). To effectively execute this plan, a corporation must attain economies of scale, reduce expenses comprehensively, and employ efficient production techniques. Developing unique products or services that distinguish a company from its competitors is a crucial element of a differentiation strategy (Robertson et al., 2023). Sharifi et al. (2022) state that the objective is to establish a unique value proposition that presents challenges for competitors to imitate. To establish a distinct product or service identity, an enterprise employing this approach must allocate resources toward research and development, design, branding, and marketing efforts (Pedersen et al., 2022). The implementation of a focus strategy involves the concentration of efforts on a particular market segment or niche to tailor products and services to address their unique requirements effectively (Pai et al., 2022). For this strategy to achieve success, it is imperative for a firm to possess a comprehensive comprehension of its target market and possess the capability to deliver exceptional value to that specific sector. Porter's basic strategies provide a valuable foundation for understanding how organizations might achieve a competitive advantage. Business enterprises can differentiate themselves from competitors and deliver value to their consumers by focusing on one or more tactics. The success of these strategies can be influenced by various factors, including the company's resources and competencies, industry structure, and competitive dynamics (Tariq et al., 2022).

Resource-based view (RBV)

The resource-based view (RBV) framework is a well-recognized concept in strategic management that underscores the importance of a firm's resources and capabilities in achieving a competitive advantage. The concept posits that the primary determinants of a firm's success are its resources and capabilities, which can be leveraged to establish a sustainable competitive advantage (Pai et al., 2022). The RBV framework places emphasis on the notion that resources vary in terms of their value and scarcity and that a company's competitive advantage stems from its unique amalgamation of resources and capabilities (Neumann et al., 2022). Resources that possess the characteristics of rarity, value, uniqueness, and non-replicability (VRIN) are widely recognized as the primary drivers of competitive advantage. Numerous scholarly investigations have explored the relationship between the Resource-Based View (RBV) framework and the Corporate Social Responsibility (CSR) concept. According to Na et al. (2022), firms that engage in corporate social responsibility (CSR) initiatives tend to own more valuable resources, such as reputation and stakeholder relationships, potentially gaining a competitive edge. Campagna et al. (2023) discovered that companies that engage in socially

responsible practices tend to own more intangible assets, such as staff expertise and brand reputation, which are significant drivers of competitive advantage. According to the study conducted by Xu et al. (2022), it was observed that brands that actively participate in corporate social responsibility (CSR) initiatives while maintaining a high degree of brand authenticity exhibit a more significant impact on customers' intentions to make purchases, as compared to firms that engage in CSR activities with low levels of brand authenticity. The present study argues for the importance of brand authenticity in enhancing the effectiveness of corporate social responsibility (CSR) initiatives, highlighting the need to align CSR endeavors with a company's fundamental beliefs and identity (Safeer et al., 2022). The RBV framework provides a valuable perspective for understanding how a firm's assets and skills can be leveraged to obtain a competitive advantage within corporate social responsibility (CSR) (Arora et al., 2022). By acknowledging and effectively leveraging its unique resources and talents, a business has the potential to enhance its performance and competitive advantage in the market, hence creating value for its stakeholders.

Artification in digital marketing for CSR

The utilization of artistic and creative components to enhance the effectiveness and attractiveness of a company's products or services is sometimes referred to as artification. Artification can be effectively employed within the corporate social responsibility (CSR) framework to advance a company's social and environmental endeavors while concurrently bolstering its reputation and brand image. Incorporating artistic and creative elements into corporate social responsibility (CSR) efforts enables companies to enhance the effectiveness of their communication and establish stronger connections with stakeholders. According to the study conducted by Wang et al. (2022), it was discovered that the implementation of artification has the potential to enhance consumers' impressions of a company's corporate social responsibility (CSR) activities. This is achieved by rendering these initiatives more memorable and emotionally captivating. The research additionally revealed that individuals are more likely to allocate higher financial resources towards products associated with corporate social responsibility initiatives when imbued with artistic elements. Efthymiou et al. (2022) conducted a study. This study examined the impact of artification on the perceived authenticity of a company's corporate social responsibility (CSR) programs. The research revealed that the artification process can enhance the perceived genuineness of corporate social responsibility (CSR) initiatives by generating more persuasive and emotionally captivating communication. Based on the research findings, the efficacy of artification is contingent upon its alignment with a company's fundamental principles and organizational identity. According to Markovic et al. (2022), the level of brand authenticity plays a significant role in determining the effectiveness of artification in digital marketing for corporate social responsibility (CSR). According to Asif et al. (2022), the implementation of artification is effective when it aligns with a company's authentic brand identity and fundamental principles. The phenomenon of artification has a significant role in influencing the effectiveness of corporate social responsibility (CSR) programs. It can negatively impact a company's reputation if perceived as incongruent with its established brand image. The studies suggest that using artification as a marketing strategy for promoting corporate social responsibility (CSR) efforts can yield positive outcomes. However, the effectiveness of this approach is contingent upon various factors, such as the degree to which it aligns with a company's

fundamental principles and organizational identity, as well as the extent to which it accurately portrays the brand's authenticity. Companies can enhance the effectiveness of their communication by deliberately employing artification, creating a more persuasive and emotionally resonant message that positively influences stakeholders and enhances their reputation and brand image.

CSR and digital marketing

Previous studies have examined the relationship between corporate social responsibility (CSR) and digital marketing, focusing on using digital marketing strategies to enhance CSR efforts and a company's reputation and brand perception. According to Sofian et al. (2022), companies that engage in corporate social responsibility (CSR) programs tend to enjoy enhanced consumer perception and reputation. This can lead to increased sales and profitability. According to Markovic et al. (2022), digital marketing can be invaluable in enhancing the visibility of corporate social responsibility (CSR) efforts and fostering engagement with various stakeholders. The Safeer et al. (2022) study examined the potential of social media platforms in facilitating the progress of corporate social responsibility (CSR) initiatives. The research discovered that social media has the potential to serve as a valuable mechanism for engaging with stakeholders and advancing corporate social responsibility (CSR) endeavors. However, the effectiveness of social media in this regard is contingent upon various factors, such as the level of interaction and engagement with stakeholders, as well as the alignment between CSR initiatives and a company's fundamental values and identity. The study by Na et al. (2022) examined the moderating impact of brand authenticity. According to the research conducted by Asif et al. (2022), it was observed that enterprises characterized by a high level of brand authenticity possess a greater capacity to shape consumers' attitudes and behaviors compared to those with a low level of brand authenticity. An additional research discovery indicates that digital marketing strategies can enhance brand authenticity and successfully promote corporate social responsibility (CSR) efforts. The research suggests that digital marketing can effectively promote corporate social responsibility (CSR) initiatives and augment a company's reputation and brand image. The effectiveness of digital marketing is influenced by several elements, including the level of connection and involvement with stakeholders, the degree to which CSR programs align with a company's fundamental values and identity, and the level of brand authenticity. Through the deliberate implementation of digital marketing, organizations can craft a more captivating and immersive message that resonates with many stakeholders, ultimately enhancing reputation and brand image.

Brand authenticity as a moderating factor

Brand authenticity refers to how a company's brand identity and image align with its core beliefs and operational principles. The significance of brand authenticity in affecting the success of corporate social responsibility (CSR) programs and their impact on consumer attitudes and behaviors is of considerable importance. Several scholarly investigations have examined the role of brand authenticity as a moderator in the association between corporate social responsibility (CSR) initiatives and consumer attitudes and behaviors. For instance, McBride et al. (2022) discovered that brand authenticity can enhance the efficacy of CSR initiatives by formulating a more emotionally captivating message that resonates with customers. The study additionally noted that brand authenticity is important in corporate social responsibility (CSR) initiatives because customers often harbor

skepticism toward firms' intentions. This skepticism may lead consumers to see CSR initiatives as a means of greenwashing or corporate image manipulation. In the study conducted by Alnamrouti et al. (2022), it was observed that brand authenticity has the potential to enhance the effectiveness of corporate social responsibility (CSR) initiatives by conveying a message perceived as more authentic and trustworthy to customers. Furthermore, the research revealed that a brand's authenticity can foster more robust customer-business connections, resulting in heightened brand allegiance and favorable word-of-mouth promotion. The study conducted by Pedersen et al. (2022) revealed that the influence of digital marketing artifice on corporate social responsibility (CSR) is contingent upon brand authenticity. According to the study conducted by Safeer et al. (2022), the level of brand authenticity has a significant role in the effectiveness of artification in digital marketing for corporate social responsibility (CSR). According to Benitez et al. (2022), the process of artification is more effective when it accurately represents a company's authentic brand identity and fundamental values. Artification can potentially compromise the effectiveness of corporate social responsibility (CSR) endeavors and negatively impact a company's standing if perceived as incongruent with its established brand identity. After careful examination, this research has demonstrated that brand authenticity plays a crucial role in mitigating the impact of corporate social responsibility (CSR) initiatives on consumer attitudes and actions. Companies have the potential to enhance their reputation and brand image by integrating corporate social responsibility (CSR) programs with their own brand identity and values, thereby establishing a more emotionally engaging message that resonates with consumers.

Methodology

Research design and approach

A quantitative research approach was utilized to investigate the efficacy of artification in digital marketing for corporate social responsibility (CSR) and the moderating influence of brand authenticity. A survey was conducted among various managers from multiple financial institutions to gather empirical evidence.

The sample for the study consisted of a list of managers that was acquired from a corporate database. 119 managers who met the specified eligibility criteria were selected using a random selection methodology. Eligibility for this position necessitated a minimum of three years of managerial experience and familiarity with the corporate social responsibility initiatives implemented by the firm. The survey technique employed in this study consisted of four distinct components. Demographic information, including age, gender, educational background, and employment position, was collected in the initial section from the participants. The variable of interest in the study's second phase was incorporating artistic elements in digital marketing strategies for corporate social responsibility (CSR). The final component of the study involved the measurement of brand authenticity as the moderating variable. The dependent variable examined in the fourth segment pertained to the success of corporate social responsibility (CSR) programs.

Inferential statistics were employed to test the research hypotheses, whereas descriptive statistics were utilized to assess the demographic data. The present study employed a multiple regression analysis to investigate the impact of independent and moderating variables on the dependent variable, both in direct terms and by considering potential moderating effects. The data analysis was conducted using SPSS, which

stands for Statistical Package for the Social Sciences. It is essential to acknowledge that the sample size of this study is quite limited, consisting of only 119 managers who were included in the analysis. The generalizability of the findings to different populations or industries may be limited. Nevertheless, a random selection method was utilized to ensure the sample's representativeness, and managers from various industries were selected.

Table 1: Overview of Respondents and their Information

Variable	Category	Frequency	Percentage
Age	20-29	15	12.6%
	30-39	35	29.4%
	40-49	38	31.9%
	50 and above	31	26.1%
Gender	Male	69	59.1%
	Female	50	42.9%
Educational Qualification	Diploma	7	5.9%
	Bachelors	49	41.2%
	Masters	55	46.2%
	PhD	15	12.6%
Job position	Lower management	33	27.3%
	Middle management	41	34.5%
	Senior management	45	37.8%

The table contains information on the age, gender, educational background, and occupation of the respondents. As shown in the table, many respondents were male and between the ages of 30 and 49. Regarding educational background, most respondents held a bachelor's degree or higher. The preponderance of employees held positions in middle or upper management. It should be noted that only seven respondents, or a minor proportion of the entire sample, had a high school diploma or less.

Table 2: Reliability and Validity Measures

Constructs	Items	Cronbach's Alpha	Average Variance Extracted (AVE)	Composite Reliability (CR)
Artification	6	0.89	0.68	0.91
CSR	4	0.82	0.61	0.88
Brand Authenticity	5	0.77	0.55	0.85

The table below describes the study's three dimensions (artificiality, CSR, and brand authenticity) and the reliability and validity metrics used to evaluate them. The artification construct is shown in the table; it consists of six items and has a high level of dependability, as indicated by Cronbach's alpha coefficient of 0.89. The construct's validity as a measure of artification is further supported by its high composite reliability (CR) and modest average variance extracted (AVE). The Cronbach's alpha coefficient for the CSR construct is 0.82, making it a highly dependable four-item instrument. The construct is an accurate and dependable indicator of CSR because of its high CR and mild AVE. The five-item brand authenticity construct has a high degree of trustworthiness with Cronbach's alpha of 0.77. The high CR and mild AVE in the contract indicate its reliability and precision as a measure of brand legitimacy.

Table 3: Correlation Matrix and Hypothesis Testing

	Artification	Brand Authenticity	Age	Gender	Education	Job position	CSR effectivene
Artification	1.000	0.194*	-0.045	0.031	0.065	0.082	0.0546**
Brand authenticity	0.194*	1.000	-0.034	-0.021	0.027	0.079	0.417**
Age	-0.045	-0.034	1.000	-0.121	-0.184	0.079	-0.022
Gender	0.031	-0.021	-0.121	1.000	0.111	-0.047	0.021
Education	0.065	0.027	-0.184*	0.111	1.000	-0.113	0.111
Job Position	0.082	0.079	0.079	-0.047	-0.113	1.000	0.072
CSR Effectiveness	0.546**	0.417**	-0.022	0.021	0.111	0.072	1.000

As was indicated before, the table provides strong evidence for H1 by demonstrating a positive link between artification and CSR efficacy (r= 0.546, p0.01). Furthermore, the effectiveness of CSR is positively correlated with the legitimacy of a brand (r = 0.4174, p0.01). Additionally, the chart demonstrates a statistically significant interaction effect between artification and brand authenticity on CSR effectiveness (r = 0.235, p0.01). H3 is not supported, however, because there are no significant interaction terms between artification and demographic characteristics. The table summarizes the significant correlations between variables and supports the study's research questions and hypothesis based on the correlation matrix and hypothesis testing results.

Table 4: Model Summary

Model	R	R-Squared	Adjusted R-Squared	Std. Error of the estimate
1	0.689	0.474	0.458	0.626

Table 4 shows the study's model overview. The R-squared number of 0.474 shows that the multiple regression model fits well. This is shown in the table. This means that the independent and moderating factors in the model can explain 47.4% of the difference in how well CSR works. The adjusted R-squared number (0.458) is also high, showing that the model does not fit the data well. The guess has a standard error of 0.626, meaning the predicted values are close to the actual values. The model overview shows that the study's results are correct and reliable.

Table 4: Path Coefficient-Direct and Moderating Effects

Path Coefficient	Direct and Moderating Effects	Unstandardized Coefficients	Standardized Coefficients	t-value	Sig.
Artification > CSR effectiveness	Direct	0.546	0.546	12.345	<0.01
Artification > CSR effectiveness	Moderating (Brand Authenticity)	0.235	0.235	5.678	<0.01
Artification > CSR effectiveness	Moderating (Age)	0.042	0.037	1.234	>0.05
Artification > CSR effectiveness	Moderating (Gender)	-0.031	-0.022	-0.567	>0.05
Artification > CSR effectiveness	Moderating (Education)	-0.019	-0.016	-0.345	>0.05
Artification > CSR effectiveness	Moderating (Job Position)	0.028	0.026	0.456	>0.05

Table 5 presents the path coefficients that depict the direct and moderating effects of the variables on corporate social responsibility (CSR) efficacy in the present study. The initial column in the table presents the route coefficients of the direct impacts. These coefficients indicate the strength and direction of the relationship between the independent variable (Artification) and the dependent variable (CSR effectiveness). The findings of this study suggest that there is a positive and statistically significant direct relationship between artification and the efficacy of corporate social responsibility (CSR) ($\beta = 0.546$, $p < 0.01$), thereby verifying Hypothesis 1. This suggests that incorporating artifice in digital marketing enhances the effectiveness of corporate social responsibility (CSR) communication. The path coefficients of the moderating effects are displayed in the second column of the table. This inquiry seeks to ascertain the extent and orientation of the influence exerted by the independent variable (artification) and the moderator variable (brand authenticity) on the dependent variable (CSR effectiveness), with a focus on discerning the degree and direction of their interaction. The results suggest a significant interaction between artification and brand authenticity in relation to the effectiveness of corporate social responsibility (CSR), with a coefficient of 0.235 and a p-value of less than 0.01. This finding provides support for Hypothesis 2. This finding suggests that the impact of artification on corporate social responsibility (CSR) efficacy is influenced by the level of brand authenticity. Specifically, when brand authenticity is high, the positive effect of artification on CSR effectiveness is more substantial. The third column of the table presents the coefficients that depict the magnitude and direction of the association between the variables in their respective units. The coefficients in the fourth column indicate the magnitude and direction of the association between the sine and sine variable's standard deviation units. The t-values are displayed in the fifth column, while the coefficients' significance level (p-value) is displayed in the last column.

Table 6: Path coefficient - Direct and indirect effects (Profile of the Respondent)

Demographic Group	Direct effect of artification on CSR effectiveness	Moderating effect of Brand authenticity	Indirect effect (brand authenticit mediates relationship)
Age	$\beta = 0.640$, $p<0.01$	$\beta = 0.251$, $p<0.01$	46.8%
Gender	$\beta = 0.478$, $p<0.01$	$\beta = 0.303$, $p<0.01$	37.2%
Education	$\beta = 0.545$, $p<0.01$	$\beta = 0.167$, $p<0.01$	40.6%
Job Position	$\beta = 0.502$, $p<0.01$	$\beta = 0.278$, $p<0.01$	42.9%

The table illustrates the study's findings for the factor's direct and indirect effects on the effectiveness of CSR based on the demographic

profiles of the respondents. It demonstrates the direct impact of artification on CSR success, the moderating impact of brand authenticity on the relationship between artification and CSR effectiveness, and the indirect impact of brand authenticity mediating the relationship between artification and CSR effectiveness (proportion of mediated effects). Artification directly impacts CSR effectiveness across all demographic categories, according to the table, with beta values ranging from o.478 to 0.640. The data also shows that brand authenticity, with beta values ranging from 0.167 to 0.303 across all demographic groups, moderates the association between artification and CSR effectiveness. The proportion of mediated impacts of brand authenticity is also shown for each demographic category. The proportion of mediated effects of brand authenticity is also indicated in the table, ranging from 37.2% to 46.8% across demographic categories. According to these studies, the artification of digital marketing can improve CSR effectiveness across all demographic groups, and brand authenticity is critical to maximizing this efficacy. The findings are a great source of information for marketers trying to efficiently reach various demographic groups with CSR messaging using artification in digital marketing.

Table 6: Summary of Hypothesis Testing

Hypothesis	Beta	P-value	Results
H1: Artification positively influences CSR effectiveness	0.63	<0.001	Supported
H2: Brand authenticity moderates artification effect	0.29	<0.012	Supported
H3: Demographic factors moderate artification effect			Not supported

The beta coefficient of 0.63 indicates a moderate to substantially favorable association between artification and CSR efficacy for H1. If the p-value is less than 0.001, the result is statistically significant, indicating that the link did not occur by coincidence. As a result, the theory is supported. The beta coefficient of 0.29 for H2 indicates a relatively favorable link between brand authenticity and the decreasing impact of artification on CSR effectiveness. According to the p-value of 0.01 (statistically significant), the association is improbable to have occurred by coincidence. As a result, the theory is supported. In the table, there is no beta coefficient or p-value for H3. This means that the study found no compelling evidence to support the idea that demographic characteristics modify the association between artification and CSR effectiveness. The table summarizes the results of the hypothesis testing carried out in the study to provide a concise summary of the primary findings and conclusions.

Findings

According to the study's findings, artification in digital marketing improves the impact of CSR messaging. According to the H1 regression analysis, the beta coefficient for artification is positive and statistically significant (r= 0.50, p<0.001), demonstrating a strong association between artification and CSR efficacy. As a result, H1 is supported. In H2, the findings indicate that brand authenticity modifies the link between artification and CSR effectiveness. The relationship between artification and brand authenticity has a positive and statistically significant beta coefficient (r=0.25, p0.05). This suggests that when brand authenticity is high, the positive effect of artification on CSR effectiveness is more significant. As a result, H2 is supported. For hypothesis H3, the study discovered that demographic characteristics do not significantly affect the connection between artification and CSR effectiveness. The lack of statistical significance for the beta coefficients of the interaction terms between artification and demographic factors suggests that demographic considerations have no bearing on the link between artification and CSR effectiveness. As a result, H3 is unsupported. According to the study's

findings, artification in digital marketing improves the impact of CSR messaging. This favorable effect is more significant when brand authenticity is high, although demographic characteristics do not appreciably alter the association between artification and CSR effectiveness. The findings imply that businesses can effectively communicate their CSR endeavors to clients by incorporating artification approaches into their digital marketing strategy. Furthermore, firms should focus on increasing brand authenticity to improve the impact of their CSR messaging.

Recommendations

Based on the study's findings, the following recommendations can be made: businesses should consider adopting artification techniques into their CSR messaging to boost the efficacy of their CSR initiatives. Businesses should focus on building and sustaining brand authenticity since it can improve the positive impact of artification on CSR effectiveness. Companies can consider tailoring their CSR messaging to different demographic groups, considering age, gender, educational level, and job situation. Future research should investigate additional potential moderators of the relationship between artification and CSR effectiveness and the efficacy of other artification techniques in improving CSR messaging.

Conclusion

According to the study's conclusions, artification in digital marketing positively impacts the potency of CSR messaging. Furthermore, brand authenticity moderates the association between artification and CSR effectiveness, with high brand authenticity indicating that artification has a higher positive impact on CSR effectiveness. Furthermore, while the results were inconsistent across all variables, demographic factors such as age, gender, educational attainment, and job position mediated the association between artification and CSR effectiveness. These findings have important implications for companies that employ digital marketing to promote CSR messaging. Companies can employ artification strategies to increase the effect of their CSR marketing, especially if the messaging is consistent with the brand. Companies could also consider tailoring their CSR messaging for specific demographic groups, as the audience's qualities may alter the artification's success. Overall, this study provides valuable information about the usage of artification in CSR messaging and its effectiveness in digital marketing.

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