Rabin Mazumder · Isita Lahiri ·
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Kanad Chatterjee · David Earp *Editors*

Resurgence and Sustainable Development of Asian Markets in the New Normal

Issues and Challenges

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Strategic Business Operations for Sustainability

Reinvigorating Asia's Tourism Industry: Strategies for Sustainable Post-pandemic Recovery

Ipseeta Satpathy, Arpita Nayak, and Md. Zahir Uddin Arif

Abstract

Purpose This study aims to investigate and assess methods for the sustained revival of Asia's tourism industry in the aftermath of the pandemic. It evaluates the repercussions of COVID-19 on the tourism industry and pinpoints essential strategies for rejuvenating the industry, with an emphasis on long-lasting sustainability. *Methodology* The researchers examined a large number of studies utilizing three major databases: Scopus (Science Direct), Web of Science, and Google Scholar. The search keywords include "COVID-19", "digitalization", "digital transformation", "pandemic effect", "responsible tourism", "tourism sustainability", "tourism sector", and "post-pandemic strategies", yielding a total of 128 articles as an initial selection from 2018 to June 2024. Finally, after screening and filtering, 36 articles relevant to the study's focus were selected for in-depth analysis. The articles were retrieved from the databases and then screened and filtered according to inclusion and exclusion criteria. The key inclusion criteria included relevance to the scope of the study, publication year, and full-text article availability. *Findings* The study proposes a comprehensive strategic plan for Asia's tourism industry after the pandemic, balancing economic development with local welfare and environmental sustainability, and promoting innovation and strategic partnerships. *Limitations* The use of terms like "COVID-19," "pandemic," "digital transformation," "responsible tourism," "tourism sector," and "sustainability" may have overlooked other relevant articles. *Implications* The study implied that the rights of unfair treatment and integration of persons in rehabilitation programs are the focus of the research. It endorses struggling groups

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and aims at narrowing down the gap between people in society. The study also offers a way of restoring the Asiatic touring business after the epidemic dented it severely. *Originality/Value* The study compiles existing literature on how to sustainably support the recovery of Asia's tourist industry from the epidemic. It seeks to establish the problems and prospects that emerge. As a result of the collection of information from various sources, it seeks to present an overview of the Asian market's tourist recovery measures. Drawing from various academic publications, it provides a holistic perspective and highlights effective strategies for policymakers and stakeholders to revitalize the tourism industry sustainably.

Keywords COVID-19 · Digital transformation · Pandemic · Responsible tourism · Sustainability · Tourism sector

Introduction

The COVID-19 pandemic impacted almost every branch of the global economy and confused such industries as tourism as never before. This paper examined the general effects of tourism on Asia; one of the findings disclosed that tourism has gone a long way in developing Asia's economy. The reduction in customers has dealt a huge blow to cash inflow and prospects for earning a living among persons. This chapter has been developed based on the measures and actions that have been performed by Asian countries to restore the sector of tourism that had an impact on the pandemic (Zsarnoczky, 2018). The tourism and hospitality industries are stable and open new employment opportunities, as well as career promotion in numerous fields connected with hospitality. There are some travel categories, for example, tourism, which entails taking a car and going for fun or with the intent to enjoy different areas (cities, countryside, natural features), observing the human history of the early ages (attractions that are historical in areas with archaeological value), and having associations with so many cultures, more cultural events, new activities, and even weather. There are many ways in which people travel. They can be internal, that is, within the nation, or external to other countries. Traveling is defined as the process of visiting other places for a recreational purpose by engaging in sightseeing and adventure activities, exploring natural and beautiful sites, knowing about other people and their cultures, and traveling for business. Such a kind of travel helps in the generation of revenue and employment in several countries across the globe. The sector consists of airlines, hotels, restaurants, travel agencies, tour operators, and any means of transportation (Ntounis et al., 2022). The boiling phase of the novel coronavirus crisis brought international travel to a complete halt. The COVID-19 issues can be viewed as having led to things like lockdowns, movement restrictions, and health-related factors that led to a decrease in the number of tourists in the fourth dimension, which was able to trigger spinner effects in hospitality, transportation, and retail. Thai, Japanese, and Malaysian nations were some of the most affected nations since they are among the most tourism-reliant economies. The

challenge now lies in these countries to strike a balance between coming out of all of this and getting back into tourism, which will put them into sustainability and resilience, as ready as they can ever be for the next shot that no one can predict. During the pandemic, Asian governments are using numerous measures to support their economies through fiscal and monetary policies and to preserve the tourist business. These are financial packages for small firms, tax incentives, and concessions for domestic transportation. The Singapore Tourism Board, on the other hand, has created strategies that are meant to assist local tourism businesses; this includes subsidies and marketing that would enhance domestic tourism. Moreover, Japan's travel subsidy program, "Go to Travel", provided subsidies to people for local travel since the COVID-19 outbreaks were not favorable. In essence, the authors' explanation enhances the sentiment that you cannot talk of tourism without talking of hotels, as both concepts appear to be synergistic. Since its creation, the Association of Southeast Asian Nations (ASEAN) has identified tourism as one of the important instruments promoting cooperation among the member countries. The same year, ASEAN Leaders decided on the establishment of the Trade and Tourism Committee, one of the five undersecretary committees in ASEAN that is under the supervision of Economic Ministers. Thus, since 1981, at the official level, the Association of Southeast Asian Nations, or ASEAN, has been functioning as an organization and began its origins in 1976 only (Hole, 2019; Öztürk et al., 2019). The significance of travel to economic regions' advancement was well understood by former ASEAN heads of state when they signed what is known as the Manila Declaration of 1987 to encourage more trips within the ASEAN region as well as build and maintain a highly efficient tourist industry. At the 28th meeting of the ASEAN Tourism Ministers in Cebu City, Philippines, the Ministerial Understanding on ASEAN Tourism Cooperation was signed in January 1998. That transaction escalated that commitment even further. Many of these goals stressed the general goal of creating and marketing ASEAN as a prime tourist site. This was done to ensure that it was posh, with quality services and things interesting to do or see that would make tourists from all over the world open their eyes in wonder. The execution of the commitment was made in the ASEAN Tourism Agreement, which was signed on November 4, 2002, during the Eighth ASEAN Summit in Phnom Penh, Cambodia. This is chronicled by the fact that the agreement also emphasizes the ASEAN plan of working through the private sector to enhance the efficiency and capacity of the tourism segment. This contains the ongoing implementation of ASEAN Member States in efforts to foster easy travel within ASEAN and other world regions. The objectives are drawn to increase market access in the procedure of the ASEAN Framework Agreement on Services, to develop high-quality tourism, to provide maximum safety to tourists, to promote and actively participate in marketing and promotional activities, and to improve the abilities of people working in the sphere of tourism and traveling (Nurrachmi, 2019). Indeed, as COVID-19 worsens its effect in different parts of the world, governments and businesses are most worried about people's health. This is still the main concern, but through financial problems and reckless spending, it has seen the plummeting of almost all stock markets in the world. It has been found that satisfaction among hotel and leisure clients took instant action, as these were among the first to feel the

force of these setbacks through a proper assessment and monetization of operational effects and such possibilities in financial issues. Some of these disruptions affect revenues as well as supplies and are difficult to predict in terms of their risks. The actions of temporarily shutting down hotels, restaurants, motion picture theaters, and similar establishments and other disruptions at a large port within the travel and tourism sector are indeed disruptive to world tourism. When business operators engage in an industry and try to work through liquidity issues along with working capital issues, inherent links are maintained between investors and participants in this sector (Baum & Hai, 2020).

The Pre-COVID-19 Tourism Industry Scenario in Asia

International travel in the Asia and Pacific region grew rapidly from 2010 to 2019. COVID-19 had not affected this specifically because, before the virus, the number of people from other countries who traveled was rising steeply. As of 2010, their number had reached 208 million. Thus, the number rose by 2019 and was above 360 million people who opted for home visits. Analyzing the impact of the sector's expansion, employment levels, and contribution to regional socio-economic development was also considered. The outbreak of the coronavirus is transcendent and has caused the shutdown of cross-border tourism, hence posing significant negative impacts on tourist receptors, establishments, and populations. However, before the emergence of COVID-19, there were certain changes in the dynamics of tourist markets because of the outbound market, consumers' attitudes and preferences for traveling, and technology. Given the findings, China was identified as one of the most important source markets in Asia and the Pacific, and it was closely followed by Japan, Korea, Singapore, other countries in the Southeast Asia region, and India, which featured as a fast-growing market. Nevertheless, before the outbreak of COVID-19, all regions marketed their destinations to attract a significant number of tourists and create products that would lead to overtourism in some of them. Holiday purposes or recreation, in general, contributed to more than half—that is, 56%—of all the global travelers who embarked on a trip as per statistical analysis a couple of years ago (Uğur & Akbıyık, 2020). Asia saw its number of foreign visitor arrivals increase at a steady rate. The United Nations World Tourism Organization established that the Asia–Pacific region was most affected by considerable increases in tourist earnings and arrivals. For instance, in the year 2019, the area attracted slightly over 360 million international tourists, and there was an upsurge of about 4%. From the previous year, it has increased by 6%, and it is responsible for providing clean air in the country. Asian countries' gross domestic product is highly dependent on the tourist industry. For example, tourism in Thailand accounts for around 20% of the total revenues; this is an indication that tourism significantly contributes to the economy of the respective country. Malaysia is not left far behind either way. The tourism business is one of their income sources, accounting for approximately 15% of their overall income. Consumers are behind the operations of such places (Deb & Nafi, 2020). It

also provided employment. Tens of millions of people were employed throughout the area in sectors such as accommodation caterers, travel agents and tour operators, tour guides, those providing transport, and numerous other services, to mention but a few. Resort development led to direct employment for at least millions more. But the direct employment opportunities extended into what economists call 'the multipliers': the employment generated in such fields as retailing, entertainment, and transport by the hospitality industry demand. Over these years, sizeable volumes of fixed capital investment have been channeled to the general hotel sector and luxury and low-end hotels in the region, in particular. International hotel chains started expanding in the large urban centers as well as in other regions that were sometimes considered the outskirts. To some extent, there emerged new types of accommodation, and among them, Airbnb became quite popular, offering customers a wider choice of hotels. This tendency was most manifested in metropolitan areas and unique locations where normal hotels were less prevalent (Tolkach et al., 2016). Looking at Asia, the said industry of travel was creating hustle before the outbreak of COVID-19. More people were coming, and they generated good revenues, creating enormous demands for other construction, beginning with buildings and hotels. As such, with the population owning houses and becoming middle-class, the region gained popularity with the residents as well as the tourists. The prospects of Asia's tourism, including new and exotic locations, together with the ability to successfully market and open new attractions, are in place for the long term. However, when COVID-19 came in, all positive outcomes were stopped, and big problems occurred. Thus, the industry needs new and sustainable approaches to restore the conditions that have been disrupted by COVID and enhance the state.

The Impact of COVID-19 on Asia's Tourism Industry

Previously, the Common Detail of Tourists was one of the biggest and fastest-growing markets globally, especially before the emergence of COVID-19. The epidemic has crippling effects on small businesses, women, and youth. As a measure to check the spread of the virus, governments closed their borders and locked down the population, meaning people were not allowed to travel, a situation that affected the world's travel and tourist businesses, while the number of tourists shrank to about 1 billion, threatening the employment of thousands of workers in this sector. It is now imperative for the sector because it relies on the support of many women, youths, and the vulnerable, most of whom are often employed by small businesses. This enables the enactment of policies that are pro-all or most people, not merely the protagonists of some categories, but enhance the business for when the horrible times come back again in the future (Huynh et al., 2021). The statistics of the United Nations World Tourism Organization depict that the Asian tourism industry has expanded over the last two decades. Arrivals of Asian tourists grew from 152.7 to 468.6 million from 2000 to 2018. Surveys of storms and hurricanes revealed that 1.6 million people died

between 2000 and 2018. Southeast Asia and South Asia had the biggest growth—higher than all the other regions of the world. Currently, the region of Asia and the Pacific is populated as a tourist attraction, and the fastest-growing region is Central and West Asia, later Southeast and South Asia. Out of all the destinations in the Asian region within the same year, East Asia, especially Japan, was most favored, with travelers visiting the region in large numbers, with a total of 285.0 million worldwide visitors. This was rather higher than the 115.4 million visitors in 2000. Southeast Asia welcomed 97.6 million visitors in 2018, and Central and West Asia attracted 41.1 million. South Asia received 23.6 million visitors; on the other hand, the Pacific region, which encompasses Australia and New Zealand, only attracted 21.2 million (Helble & Fink, 2020).

Through recent research carried out by South Asian Development Solutions (SEAD) (2021), it was predicted that Southeast Asia's gross domestic product could potentially decrease by 8.4% in 2021 if people still delay their travel plans because of the pandemic that started in 2020. In this regard, relative to recent research, a United Nations estimate shows that the expenses that incoming tourists are expected to spend this year have significantly reduced by 82%. The United Nations World Tourism Organization and the United Nations Conference on Trade and Development, in their joint study, predicted that the COVID-19 epidemic will last for a few more years. They advocate that countries set up mechanisms that allow for travelers' confidence to gradually be rebuilt, minimize adverse social-economic impacts, and, most importantly, position the travel and tourism industry for future sustainability. The global cumulated number of COVID-19 cases until July 14 numbered 187.5 million people; 4 million of them died. Southeast Asia, which consists of 11 countries, had 36,000,000 cases of sickness and 516,608 deaths. In this research by the UN, global tourist arrivals are expected to be reduced by 74%, which was the case last year. Typically, the least developed countries with a high proportion of the population depending on the tourism industry have experienced tourist flows reduced by 80–90%. The survey also showed that regional European tourist consumption was least affected by the global tourist downturn, followed by South American, Central American and Caribbean, Middle-East, and African tourists, while the hardest hit tourists were those from Southeast Asia, Northeast Asia, Oceania, North Africa, and South Asia. North America, Western Europe, and the Caribbean did have a large decrease, although they did not have as significant a decrease. The impact analysis shows that even in the best-case scenario of a 63% rate decrease, Southeast Asia's gross domestic product might decrease by 5.6% this year. Besides, even if vaccines have been administered and distributed, should net enrollment experience a 75% decrease, the GDP would only shrink by 7.1%. In 2019, the World Travel and Tourism Council estimated that the travel and tourism sector contributed $380 million to Southeast Asia's GDP, accounting for approximately 12% of the region's overall economy. Revitalizing tourism in the new normal requires the implementation of strong health and safety protocols to restore travelers' confidence. For instance, Thailand introduced the "Amazing Thailand Safety and Health Administration (SHA)." This program issues certifications to hotels, restaurants, and tourist attractions. It also guarantees that the said spaces are clean and free from risks to the health of the people who work

or frequent the area. This is important for the provision of health care and creating the impression that makes travelers more comfortable visiting. They are using more digital applications for the promotion of the tourism industry. Situations concerning COVID have made more areas adopt items such as touchless payments, health passes, virtual tours, and AI assistance for consumers. And China shows that, through technology, one's travel could be safer and more enhanced. They use quantitative analysis and AI to reduce the flow of people to some places and enhance their touristic trips. South Korea has also applied some wise tourist policies (Assaf & Scuderi, 2020).

Research Questions

The following research questions address the issues in the tourism and hospitality industries of Asian countries:

RQ1. What issues have tourism firms in Asia faced since the COVID-19 pandemic hit?
RQ2. How have different Asian countries changed their tourism strategies to boost sustainable recovery in the tourism and hospitality industries during the post-pandemic period?
RQ3. How does community-based tourism in different Asian countries plays a crucial role in the sustainable recovery of the tourism and hospitality industries during the post-pandemic period?

Research Objectives

The study's particular objectives are as follows:

RO1. To identify, understand, and analyze the significant issues encountered by the tourist and hospitality industries in Asia during the post-pandemic recovery period.
RO2. To understand and examine the techniques taken by various Asian countries to boost sustainable recovery in the tourism and hospitality industries during the post-pandemic period.
RO3. To understand and examine how community-based tourism in different Asian countries plays a crucial role in the sustainable recovery of the tourism and hospitality industries during the post-pandemic period.

Research Methodology

The study was conducted based on a comprehensive literature review using three major databases: Scopus (Science Direct), Web of Science, and Google Scholar, which were selected because these databases draw publications from various disciplines and would provide the largest source of the most recent literature on the challenges and solutions in Asian tourism in the post-pandemic period (Widjaja et al., 2023; Zolfani et al., 2015). Selective filtering was used, emphasizing publications only from journal articles from 2018 to 2024 rather than book chapters or textbooks (Widjaja et al., 2023).

The first step was to search these databases using the keywords "COVID-19", "digitalization", "digital transformation", "pandemic effect", "responsible tourism", "tourism sustainability", "tourism sector", and "post-pandemic strategies", yielding a total of 128 articles as an initial selection from 2018 to June 2024. After that, the articles were screened according to their relevance to the scope of the study, year of publication, and full-text article accessibility, which accounted for 93 articles (37 articles from Scopus, 17 articles from Web of Science, and 39 articles from Google Scholar). Next, the articles retrieved from the databases were then screened and filtered according to inclusion and exclusion criteria (Khan & Arif, 2023; Widjaja et al., 2023). Following the exclusion criteria, 57 out of 93 articles that did not align with the study's focus area were eliminated. Then only full-text articles from peer-reviewed journals relevant to the study's focus area and the most recent ones in the field were selected and included. This process assisted in identifying 36 articles relevant to the study out of 93 articles (13 out of 37 articles from Scopus, 7 out of 17 articles from Web of Science, and 16 out of 39 articles from Google Scholar) that were selected for in-depth analysis. Finally, the ideas, methodologies for analysis, and theories from the selected articles were examined, and common themes, patterns, and findings were revealed.

Results and Discussion

The literature review consists of 36 articles that aim to present and explain the existing problems of Asian tourism in the context of the post-pandemic period, as well as the solutions suggested for them. Topics discussed in these articles included the digital business transformation of tourism, sustainable tourism development and management, and eco-tourism. During the study, the primary areas of concern and strategies that are vital in the process of reactivating the tourism sector in Asia post-COVID-19 have been determined. Supporting community involvement in tourism development was determined to be one of the possible strategies. Incorporating the local people in the decision-making processes and encouraging local businesses, therefore, can make tourism more sustainable. It is also easier to work in collaboration with other countries to set up standard measures and couple efforts to push for an

increase in recoveries. This involves market cooperation, for instance, using joint advertisements for marketing and cooperation in matters touching on the tourism sector. Based on the identified issues, new approaches can be created and cooperation between tourism-related actors promoted to ensure the sector's growth and resistance to adverse situations. This entails the development of new forms of organizations and the enhancement of corporate networks. The study implies that multiple interventions are needed to effectively restore Asian tourism in the long run. The enhancement of safety measures coupled with innovation, policymaking, and environmentalism can build up a secure matrix for the sector's recovery. Through engagement with communities and international partnerships, Asian countries can realize a tourism sector that is stronger and capable of overcoming future difficulties. To put into practice these strategies, support from the authority and government of tourism and the collaboration of other partners in the private sector are crucial. Customers and the industry's observing authorities should enhance and maintain health standards and encourage the use of advanced technologies and green tourism practices.

Revitalizing Asia's Tourism: Government-Led Recovery and Resilience Strategies

The global tourism industry has been presented with a challenge that has no precedence because of the COVID-19 pandemic, particularly impacting Asia. Successive Asian governments have recognized the functions in the provisioning of such necessities concerning the role of tourism in their economies and have developed various fiscal policies and measures to help restore the economy had it been injured, crippled, or destroyed through acts of aggression. These efforts were endeavored to stabilize the sector, protect employment, and build the preliminary structure for a successful and efficient future (Dash & Sharma, 2021). In this regard, the government has launched, over the years, different strategies aimed at developing tourism. Some of them are the Swadesh Darshan (Homeland Philosophy) Scheme, Pilgrimage Rejuvenation, and Spiritual Development. Of the Tourism Ministry, Integrated Development of Island Territories, and National Waterways. Homes only; virtual tours; Spiritual Heritage Augmentation Drive (PRASHAD); Dekho Apna Desh (Look at Your Country); and the Adopt a Heritage Scheme. Also, the enhancement of the e-visa service means that nationals from 169 countries can choose from five sub-categories: 'e-tourist visa', 'e-business visa', 'e-medical visa', 'e-Medical Attendant Visa', and 'e-Conference Visa'. Moreover, the new imprint on the 5 year e-tourist visa with multiple entry provisions has been made, while at the same time, there has been a cut in the visa. Various measures have been implemented; measures for multiple entries have been brought forward while at the same time increasing the stringency of visa fees. Thus, it can be rightly stated that the measures have helped in turning around the situation of foreign tourist arrivals (FTAs), which increased successfully from 10.04 million in

2017 to 10.93 million in 2019, resulting in an increase in foreign exchange earnings from US $27.3 billion to US $30.05 billion (Beh & Lin, 2022).

Due to the decline in international tourist arrivals, governments in different countries have shifted their attention to domestic tourism. Domestic tourism advertising is among the major strategies that have been affected by the recovery. In a bid to tempt Indians to explore different places in the country, India introduced its "Dekho Apna Desh" ("Look at Your Country") campaign, and to back this up, there is reimbursement on expenses such as affordable accommodations and travel vouchers. Ministries have stressed the need to devise strategies for standard health and safety measures simultaneously with these attractive incentives to restore the confidence of intending tourists. To establish trust, governments and various destinations' stakeholders developed measures and certification systems to show their readiness to protect the health of visitors and residents. For instance, there is the "Amazing Thailand Safety and Health Administration" in Thailand that ensures that hotels that have been accredited conform to hygiene norms. These were crucial to bolstering confidence and instigating domestic as well as international travel (Nhamo et al., 2020). Being one of the leading destinations globally, Singapore has been presenting some of the most effective and versatile measures to restore the mutilated tourism industry. The government even established a "Tourism Recovery Action Taskforce" (TRAC) to further envision and strategize how they can assist the industry. During the period under analysis, the government enacted several policies under TRAC, for instance, the "Tourism Sector Assistance Package," in which the government offered subsidies to the tourism firms for operating expenses and to adopt technology improvements. To lead revival efforts, the Singapore Tourism Board (STB) recently launched a nationwide SG Clean campaign to increase cleanliness and hygiene standards within the tourism industry. The campaign entailed plenty of accreditation processes that insisted on higher compliance with health standards for businesses that were given the endorsement symbol "SG Clean". Apart from being an assurance label, it was also to improve tourist confidence in the safety and quality of Singapore (Koh, 2020). Public–private partnerships (PPPs) are regarded as significant in the process of tourism and the recovery of several Asian countries. Through PPPs, resources, knowledge, and innovative solutions for the various aspects of the pandemic have been assembled. In Asia, PPPs have started massive marketing to revive the tourism industry. For instance, TAT partnered with airlines, hotels, and travel operators—the private players in Thailand—for its "Rediscover Thailand" campaign. Thereto, concessions on selling tour packages to destinations were provided, accompanied by other marketing strategies to initially promote domestic tourism in the region to revive a stale economy. Similarly, Japan also made successful PPPs as the government collaborated with the private sector to start the "Go to Travel" program, in which up to 50% of tour expenses for domestic tourists, inclusive of transport, accommodation, and even shopping, were subsidized. Consumption of locally available products helps in the survival of the sector while still adhering to the medical recommendations (Tahili et al., 2022). PPPs play a decisive role in the introduction of innovations and help the tourism industry overcome difficulties. Information technology companies in South Korea work with the government to create new tools for smart tourism. They use intelligent

technologies and a vast quantity of data to make things better for travelers all around the world. Apart from gaining more customers, South Korean tourism authorities were able to present innovative ideas for virtual reality (VR) tours. Therefore, South Korean tourism authorities were able to attract more guests and establish the image of the country as an innovative leader in technological tourism. The detailed strategy for the tourism sector's revival is therefore multifaceted and incorporates government measures, funds, and cooperation between the public and private spheres. It is in this regard that appropriate and balanced fiscal policies, cooperation, and innovations can turn into the silver bullet that Asian nations need to reconstruct the beleaguered tourism industries as sustainable and resilient as possible. These efforts are not only necessary for recovery in this industry and the economy but are also necessary for the stable and further development of the tourism industry in the post-COVID-19 world. Singapore proves that state-sponsored targeted measures and collaboration with partners will lead to a successful recovery and can be used by members of the Association of Southeast Asian Nations.

Post-pandemic Tourism: Rebranding and Marketing Initiatives for Recovery and Resilience

The COVID-19 has disturbed the international tourist trade. Therefore, the existence of such a great change is putting demands on travel businesses to look for new and unique ways of marketing their businesses. They also need to rebuild to rejuvenate the people's interest in traveling, given the disturbances that have occurred. When it comes to the process of stimulating new tourism offers, the emphasis now moves towards composing "safe, sustainable, and unique" narratives. It is crucial to apply proper strategies of rebranding to foster trust in the tourists and re-establish excitement regarding the tourist destinations. In general, the tendencies of the tourist business were rather competitive, and pricing was almost always difficult to analyze even before COVID-19 (Skinner, 2021). Post-pandemic, one of the most prominent strategies of full-spectrum rebranding is safety-and-hygiene rebranding. Most places have reinvented themselves as safe havens, thanks to the promotion of health standards and accreditation. In response to this, Thailand introduced the Amazing Thailand Safety and Health Administration (SHA) to users to reassure them of the measures that had been put in place. It has also been frequently applied by advertising agencies to reassure an intending tourist. Singapore implemented the SG Clean certification, which was a standard set for cleaning and hygiene. This too has been brought out vividly in the marketing communication to reassure (or compel) the travelers (Sharma & Arora, 2024). Especially, the emphasis on developing local and sustainable tourism has grown as destinations turn their attention to domestic visitors. Such campaigns that have emerged recently, like "Rediscover Thailand" and India's "Dekho Apna Desh" ("Look at Your Country"), fall under this genre and

have been effective in relevant countries. Besides these campaigns, other quantitative stimuli, including promotional fares such as discounted travel packages and travel vouchers, have boosted domestic travel. For example, Japan's "Go to Travel" campaign offered large discounts, up to 50% of the costs of domestic travel, thus positively affecting local tourism and supporting the regional economy (Pongsakornrungsilp et al., 2021). Sustainability is one of the most important concepts involved in the process of rebranding destinations. Many other locations are already advertising sustainability, recycling, wildlife, and socialized tourism to entice tourists to seek out suitable environment-friendly options. Consider Bhutan, which has been promoting itself as a sustainable tourism destination for several years, referring to the GNH concept as well as concrete tourism products. Post-pandemic, this commitment to sustainability has not changed: the country continues to advertise its unspoiled nature and Indigenous people, and on this beautiful background, you can add offers for environmentally friendly hotels and tours for those who are interested in environmentally friendly tourism (Brown-Williams & Charles, 2021). One of the crucial techniques that needs to be implemented in the rebranding process is the creation of new stories and events. Warnings have been taken that destinations are also aligned with the message that they use to market themselves to fit the changing trends of travel. An example of this is the appearance of new types of tourism known as "workstation" or "work vacation" packages, which have occurred because of the necessity for remote workers. In response, Barbados introduced what is called the "Barbados Welcome Stamp", which is a visa that allows those individuals to work remotely in the country for one year. It has managed to attract digital nomads and remote workers who are out in search of a change of scenery and has directly impacted the country's tourism industry (Fountain et al., 2021). The Indonesian government employed digital networks and social media to achieve a better success rate in rebranding the post-marketing campaign, enabled by the Tourism Ministry's Director General for Marketing partnering with contemporary cultural artists who marketed this new image through Instagram stories and daily feeds with the interesting pictures or videos uploaded, as well as other social media platforms such as live video on Facebook or videos on YouTube. Emotional message vibes attract more people if the location is crowded (Rudenko et al., 2018). The specifications of the digital campaign also encouraged people to share their real-life travel experiences to inspire others and encourage those who have traveled before to share their experiences with others who are possibly considering traveling. Another noteworthy promoted hashtag included #WonderfulIndonesia which helped in the encouragement of user-generated content production, building a community feeling, and fostering engagement. Not only that, but Indonesia benefited from this to the fullest and not only utilized the virtual experience angle but also the advertising angle, where they could specifically advertise certain destinations that are in Indonesia. One such campaign, "Bali: A New Kind of Adventure", recommended Bali as the center of tourist attractions and adventure activities such as hiking, surfing, and diving. This was supposed to capture the adventurous and other recreational people because there has been an increased attraction to adventure tourism. The approach applied to this kind of marketing was collaboration with influencers as well as travel bloggers. Therefore, it is possible to

produce information that is truly Indonesian yet realistic once the promoters involve influential users with a large number of fans to showcase diverse Indonesian sights. The collaborations with influencers also extended the reach of the campaign and were becoming more credible, such as the one below. For example, influential travel companies shared the discovery of new and untouched places in beautiful Indonesia, which attracts with its versatility and opposites (Rosadi et al., 2022). Thus, one cannot overemphasize the potential of social media and digital platforms as marketing and rebranding tools, especially in life after COVID-19. These platforms provide the best features, which can help marketers reach out to the mass market in the right way, identify the market, and even evaluate the effect of the campaign that is to be launched. Digital marketing is primarily a means of advertising and personalization. It is noteworthy that by using the analytical approach, the target clientele will be segmented through characteristics such as age, gender, rate of travel, and so on. This assists in creating a plan that can be resourcefully applied, in which marketing appeals would mainly be appropriate for the travelers in these specialized niches. For example, advertising tourism as an adventurous product to youths who consider themselves adventurous people or advertising healthy living through the consumption of healthy foods using tourism will increase the level of engagement as well as the conversion rates. One such example is the 'Go to Travel' campaign that was undertaken in Japan; preferential travel packages that were formulated from the data analytical results of the different segments of the population were offered to travel, resulting in enhanced domestic travel (Qureshi & Dada, 2019). Wellness tourism has also been seen as an attribute in the case of rebranding strategies as well. For instance, Indonesia and Thailand have marketed the services of well-being centers, workout facilities, spas, and so on. This is well positioned to fit into the current experience of healthy holidays that tourists are increasingly looking for in large numbers. For instance, Thailand has excellently marketed its wellness products, which include Thai massages, meditation, and wellness centers. At the same time, it was pointed out that, for example, adventure tourism is also one of the fields where destinations develop new stories. Some countries, including Nepal and New Zealand, for instance, have aimed to promote their adventure tourism commodities, including trekking, mountain climbing, bungee jumping, skydiving, etc. As the key brand appeal, most of these destinations have focused on adventure when marketing their rugged landscape attributes to the regions. However, COVID-19 has adversely impacted the Nepalese 'Visit Nepal 2020' by continuously utilizing digital marketing communication to promote adventure tourism (Lötter & Welthagen, 2020).

Emphasis on Eco-tourism and Responsible Travel: Strategies for Tourism Recovery in Asia

The COVID-19 epidemic has helped bring forward the introduction and development of green and environmentally friendly tourism. This is important for Asian

countries, given that tourism forms the backbone of their economies. Individuals are not merely focusing on going green because the large number of tourists impacts the environment negatively. This is an efficient strategy to rebuild and enhance the situation after the epidemic. The tourist industry is currently moving as an increasing number of people look for eco-friendly facilities and services. It is far beyond the preservation of the world, and it is a cycle that encompasses recovering from every challenge that has befallen the tourism industry so that it, in turn, becomes ready to face future hurdles. Other things being equal, sustainable tourism developed as the other options became more attractive, proving that the business adapted to the needs of modern tourists. This change heralds more awareness of environmental issues as well as a commitment to sustainability from both consumers and the actors in the travel tourism stream. Eco-lodges, sustainable resorts, and green-certified hotels are a growing segment that has developed unique signatures to focus on sustainability and the conservation of the natural environment (Choi et al., 2020). It has been realized that eco-lodges are the main driving force behind sustainable tourism. They are in picturesque nature backgrounds and strive not to have as little an impact on the surroundings as possible. What is more, these places often use local materials, work based on renewable energy, and carry out measures to minimize waste. Many unpronounceable examples are seen; one of these is the Misool Eco Resort found in Indonesia. Previously, it was a place where sharks were killed for their fins, but now this place offers ecologically friendly tourism and aims to protect the inhabitants of the ocean. Tourism in Misool involves activities such as the restoration of coral reefs and an opportunity to join other educational activities on the need to conserve the natural environment (Wallace, 2019). Eco-resorts go a notch higher in hotel industry practices because they incorporate green practices into their operations. Even such issues as the use of energy-efficient buildings and structures, the use of water, and the sensitivity to organic food buying are also witnessed in these resorts. It has been practiced in Six Senses Resorts in Thailand as well as Vietnam as one of the earliest applications of sustainability. The Six Senses take sustainability as a very sensitive issue and practice some activities such as farming fresh foods for their restaurant complaints, controlling waste such as plastic, and practicing recycling. The resorts equally participate in community interaction through procuring local products and services and providing employment for the locals (Kaiwa, 2017). Hotels that are certified as green follow strict environmental standards established by certification organizations like Green Key, LEED (Leadership in Energy and Environmental Design), and Earth Check. Such certifications guarantee that the hotels are least impactful on the environment on issues to do with energy and waste management and material sourcing for consumption or use. An example of such a hotel is the Hotel ICON in Hong Kong, where most of the green initiatives include the LEED Gold certification and the practices elaborated in the given paper. Some of them include the use of solar panels, rainwater collection, and efficient recycling. Also, the hotel is very considerate of the use of foods produced within the local region and organic foods in the restaurants to reduce the release of gases and support local farmers (Chung, 2020). It is important to note that numerous green hotels have a close working relationship with managing alternatives to the preservation of the physical world. Currently, there

exist many splendid and stylish lodges and ecological hotels that are situated within or in proximity to the protected areas, with their primary function being the conservation of species. An example of this is the "Chumbe Island Coral Park" established in Zanzibar; it acts as a private nature reserve with the intent to preserve the coral as well as the land above it. The bungalows in the park incorporate the use of environmentally friendly technologies that rely on solar; the park also practices rainwater collection. Visitors can move around the park through guided tours to understand the findings of the local vegetation and animals and the conservation initiatives taken for this park (Sharma & Sarmah, 2019). Sustainable tourism pays a lot of attention to the involvement of the communities in those regions. Sustainability is very often related to the employment of local people and the purchasing of goods and services from the country an establishment belongs to. It also contributes to the improvement of the local economy, while at the same time, the necessary virtues that are needed to maintain the environment are fostered. An example of this approach is the Lisu Lodge, situated in Thailand, which is a community-based eco-lodge supporting the Lisu Hill Tribe. This is good ground for cultural activities like dancing and, on the other hand, crafts that will be entertaining to the guests and, at the same time, boost the income from tourism for the community (Dayneko & Dayneko, 2018). On the other hand, Europe and the Middle East region have successfully reached over 50% of the arrival numbers that prevailed before the onset of the crisis. This implies that recovery rates were variable and considerably lower in the areas of Central and South Asia with a 33% rate, Southeast Asia with a bare 12% rate, and the Pacific with an average of 28%. This is expected to change in 2023, when more places that include the People's Republic of China as a major player in outbound tourism will open their international borders to tourist activity in January 2023. According to the Asian Economic Integration Report (AER) 2023, 61% of the UN World Tourism Organization experts are convinced that international tourism is going to take several months to a year or more to return to the pre-crisis level, and even some of them are supposed to believe that it will happen no earlier than in summer 2024. Flourishing global economic recessions, inflation, and geopolitical challenges may slow down the rate of recovery mechanisms. This is why immigration from Asian countries has been impacted by the Russian invasion of Ukraine because Russia was a tourist hub before COVID-19, and a third of gross entries included Russian tourists. The cost of jet fuel is skyrocketing in Asia, which is hampering the revival, reducing flights, and increasing fares. Higher inflation also affects the level of tourism through a reduction in travel. The percentage of intraregional share in Asia's outbound tourism is demonstrated in Fig. 1 (Latoja & Basu-Das, 2023).

Water management is a well-known component of sustainability, especially in the facilities of hotels and resorts. To conserve water, many green accommodations have adopted several measures, such as showers with installed low-flow showerheads, flush toilets that have dual options, and hotels that have reincorporation systems for "grey water" that is from sinks and showers. For instance, at this Zuri Zanzibar resort in Tanzania, there is indeed a plant that treats sewage and salt water, and the freshwater produced is used to supplement the limited water supply system. They also have a system that treats and reuses grey water for cleaning activities and irrigation of

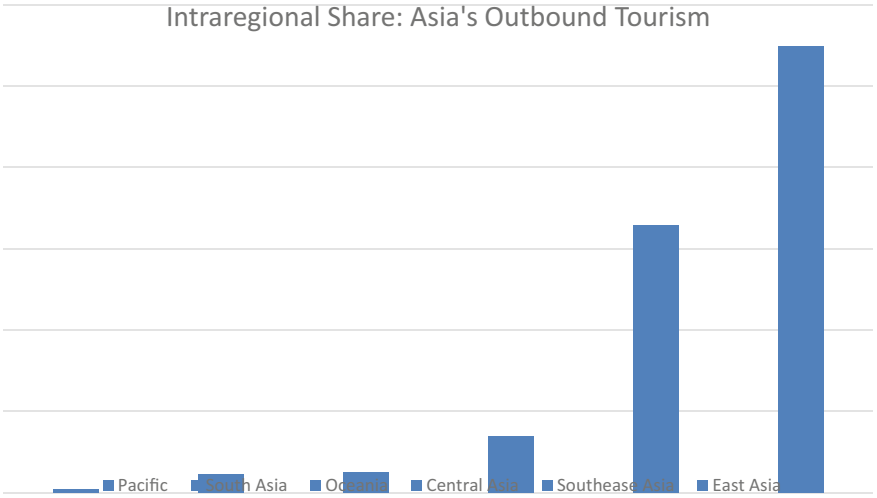

Fig. 1 Intraregional share: Asia's outbound tourism. *Source* Adopted from Latoja and Basu-Das (2023)

plants, which helps with the unnecessary waste of water (Ghosh et al., 2017). Another aspect of hotels that could be more environmentally friendly is the application of innovative technology. This includes products such as smart thermostats, energy-efficient lights, and automated systems, among others. They assist in cutting down on the use of energy and enhancing the efficiency of the management systems. For instance, the Hotel Sezz in Saint-Tropez, France, has a smart energy management system in guestrooms that controls lighting and temperature according to occupancy. This qualifies the use of energy, thus making it efficient. For the same reason, the hotel also offers general and application-based information about environmentally friendly activities and sites or attractions (Huang et al., 2016).

Limitation of the Study and Future Research Direction

Limitations of the study to only research and literature reviews may sometimes be a disadvantage since it fails to expand beyond the existing literature. If it does this, it may not have access to the developments of this method, newer trends, and sharper and more current information that may be obtained from primary information. The legal databases where the literature review sources were obtained may not contain the entire array of research studies, especially those published in local or less reputable journals. This means that the study can miss out on key viewpoints and information concerning some Asian locales. The publication type in the study also limits the study even further in that it restricts the evidence to only data that was published in certain databases and within a specific time frame. One of the limitations of the

study is that the results may not be generalizable to other parts of the world because the study was conducted within Asia's confines by and large due to differences in economic, cultural, and environmental parameters. The synthesized data from the concerning studies could contain the biases and limitations of the prior studies. This involves the possibility of reporting bias and disparities in the quality of the studies conducted in the source articles. These limitations show why future studies must embrace the use of primary data collection and extend the geographical coverage of the study to validate this research study's findings. Subsequent research actions, specifically in terms of continued and perhaps longitudinal work, will concentrate on the post-pandemic measures that have been applied. This means carrying out a longitudinal study regarding the recovery of tourism over time to evaluate the applicability and impact of the various intercessions. Concerning social outcomes, identifying people's level of resilience helps develop better foundations for policies and practices within the crisis for later use. Analyzing the effects of such innovations as artificial intelligence, blockchain, and virtual reality in the tourism sector is important to understand how they can enhance safety, efficiency, and consumer satisfaction. This will perhaps require further study to find the specific uses of these tools to build better and more resilient structures in tourism.

Implications of the Study

Theoretical Implications: Replacing the evaluation of existing data with new results indicates that relying solely on previous studies hampers our comprehension of the issue relating to sustainable tourism recovery. The significance of this research is that it provides a multifaceted approach to the strategies adopted post-COVID-19 shocks, where audiences are privileged to acquire more knowledge about rebuilding the tourism industry. Thus, by collecting information from diverse sources, this research contributes to increasing the body of knowledge regarding tourism resilience and sustainability. It also adds to what is known now by illustrating how health and safety measures, digital solutions, and sustainability complement each other to revive tourism. Firstly, the study puts forward a model that can serve as a framework for future works, thus having a rather solid warrant for the development of the field. This interdisciplinary analysis of the subject indicates that economics, environment, and social factors are vital aspects that should always be incorporated into the discourse on tourism recovery, hence the significance of presenting a broad perspective to enrich knowledge and guide policy formulation.

Practical Implications: This research offers policy implications and suggestions for future work for policymakers, tourism firms, consumers, and Asian communities. This study points to accurate recommendations on how to make tourism better equipped and sustained even after the epidemic. For example, it offers to lay emphasis on health and safety regulations and adopt more of the new technology due to the new change in the operation of tourism. It also reveals that more work needs to

be done in the field to support the recovery of tourism, and assistance is required from others in the field. If applied by tourist firms, they can remake their structures, enhance their services, and remain viable for quite a long time. These proposals help in creating some specific strategies concerning the number of problematic issues that the various sectors in Asia encounter, thus enabling the formulation of respective strategies meant for the revitalization of tourism.

Social Implications: This study is useful to society as it presents valuable information on gender-related matters. This proves that the community must be involved and that tourism recovery has to be equal. Strategies that are aligned with local inclusion priorities should be implemented. This makes sure that every sector benefits at the same level in the case of tourism. This is not only a cause that fosters social interaction and expands economic opportunities in society; it also improves the character and engagement of tourists with tourist attractions (Arif et al., 2011). It also explains the need to avoid the negative impacts of tourism on the environment. This assists in conserving wildlife for future generations. Overall, by focusing on equity and the environment, the study allows for participation in grand or unrelated projects aimed at making the world a better place. This calls for the implementation of measures that promote poverty minimization, enhancement of people's well-being, and protection of the environment biologically, as evidenced by the study.

Recommendation and Conclusion

Asia can bring back its sources of tourism after COVID-19, but it must take several steps. To ensure Asia's sustainable tourism development, a comprehensive master plan should be adopted. Tourism development has both positive and negative effects on Asia's society, economy, culture, and environment. Thus, to accomplish sustainable tourism development, tourists' current and future needs must be balanced (Arif et al., 2011). All tourism destinations must be safe and healthy, employ the best technology, be environmentally sound, listen to the locals, and collaborate with other countries. More specifically, improving safety standards, giving certifications, and training people a lot would enhance tourists' reception and ensure safety for everyone regardless of the place they are in. Applying present-day, more sophisticated equipment, dealing with immense data, and seeing to it that the content of the web is safe can make travel exciting and safeguard essential computer gear. If nature is conserved, everyone can help local people develop their tourism businesses, which will be more favorable for the Earth and more equitable to residents. This collaboration will essentially change the functioning of the Asian tourist industry. It will create new thoughts, enhance corporate connections, and focus on responsibility concerning the environment. This enables travelers to have safe and pleasant trips while simultaneously bearing the responsibilities of boosting the economy and conserving people and natural resources. To restart Asia's tourism after the COVID-19 pneumonia

outbreak, all of the mentioned factors must be taken into consideration. Unfortunately, Asian countries may have to recreate the tourist industries in a more efficient, effective, and sustainable manner after understanding the shortcomings they faced and the new opportunities the crisis offered them. Regional strategies applied for the revival of tourism in Asia have not specifically addressed restoring the level of tourism consumption to pre-crisis numbers. What it means is the transformation of tourism, which would encourage the development of proper strategies for the future. The strategies mentioned in this article are meant to create the type of tourism that can function perfectly in the post-COVID-19 world, where efficiency and sustainability, the development and welfare of the population, as well as the preservation of the terrestrial sphere, may constitute a single and indivisible value. Achieving innovation, developing partnerships, and promoting sustainability make Asia's tourism industry ready to achieve stronger and faster responses to the recovery in the future; ensuring travelers have a high-quality and secure experience.

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Integrating Employee Engagement Practices with Corporate Social Responsibility: A Special Focus on Generation Z

Savita Shastri and Dipak Saha

Abstract An individual spends a big quantum of his life at the place he works. Organizations are like second home to many, hence the satisfaction that they derive at workplace becomes a critical determinant in the quality and longevity of work life. Engaging employees has become an important piece of the Employee Satisfaction Puzzle and is a key driver in the success of any organization. Disengaged employees can prove to be a liability and cast a detrimental effect on the future of our organization. Generation Z also called as 'Zoomers' are posing to be a big challenge for employers as they come in with tremendous energy and varied interests. Engaging Generation Z is extremely essential to ensure higher satisfaction and retention levels. One of the ways to engage them proactively would be to make them part of the CSR activities that an organization undertakes. The concept of Corporate Social Responsibility deals with the ways an organization can provide and create social value, what best it can do to bring a change in society and the world at large. Using Employees as Volunteers and flag bearers of CSR can help the organization in building a positive brand for itself on one hand and enhance employee satisfaction levels on the other hand. The article talks about bringing a sync and integration between the Corporate Social Responsibility of an organization and the concept of Employee Engagement. Engaging employees especially the Gen Z in a wide range of Socially and Environmentally relevant activities could prove to be a differentiator and a sustainable business practice. Engaging employees in socially relevant activities would bring in a sense of pride and satisfaction among the employees. This indirectly influences the employee opinion and perception towards the management and helps in creating a positive brand image in the market at large. Disengaged employees prove to be a barrier in the growth and advancement of an organization. Hence, CSR could be used as a potential tool to enhance employee engagement and employee commitment in the organization. This would indicate killing two birds with one arrow, the

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arrow being CSR and the birds being social commitment and employee satisfaction. Both of these would contribute in creating and sustaining a brand image and bring competitive advantage for the organization.

Keywords Corporate social responsibility · Employee engagement · Generation Z · Zoomers · Employee satisfaction · Sustainable business practice

Introduction

Employee Engagement has been an area of interest and challenge for HR Professionals throughout the globe. With the working population comprising of a big chunk of Gen Z, it has become imperative to provide various options for their engagement and involvement. Gen Z are categorized as people wanting to explore, looking for change and willing to contribute and go an extra mile. Researchers certify that engaged employees are more focussed and committed towards their work as well as their organization. Employee Engagement does not only mean how happy an employee is at work. Engaged employee is the one who feels connected with the company's mission and is focussed towards delivering his part in accomplishment of organizational goals.

Corporate Social Responsibility is another term that has gathered immense attention over the past decade. CSR helps an organization augment the loyalty and commitment of their customers and employees which in turn enhances the brand image and sustainability of the organization. Allocating funds for Social and environmental issues has been the generic trend in the field of CSR. Most Organizations tie up with NGOs who are committed to one of the many social issues or have their own foundations cover up the CSR segment. The organizations worldwide have come to realize the importance of contributing and associating with a social cause. Creating a positive and socially responsible image in the minds of customers can prove to be very beneficial for the success and growth of any business enterprise.

Integration of Employee Engagement Practices with the Organization's CSR activities can prove to be a motivator and a driver for Gen Z employees to continue and work whole heartedly. 'Zoomers' are characterized with high potential and high energy levels which could be channelized towards CSR activities to deliver effective results. Engaging employees in CSR activities would ensure there is a connect between social needs of employees and service needs of the organization. The organization through its employees could serve the society and make a mark in the market. The integration between employee engagement and CSR could prove to be a win–win situation for the employees, organization and society as well.

Theoretical Background

Employee Engagement: Employee Engagement refers to the connect that employees have with their organization. Employee Engagement describes the feeling of dedication and motivation that an employee feels towards his work and workplace. Engaged employees value organization's goals and vision and are internally motivated to contribute to organizational success.

The 5 C approach to employee engagement is followed by many organizations as it helps in creating an engaged workforce. The first C is 'Care', which refers to the understanding that an organization has of the needs and feelings of its people. When employees feel that they are not being cared, they tend to display disengaged behaviour. This disengaged feeling often results in 'Quiet Quitting'. Such disengaged employees tend to leave the organization despite receiving tangible benefits. Caring constitutes of intangible elements such as flexible work patterns, work life balance, supportive environment, appreciation, and recognition. The organization must ensure physical and mental wellbeing of its people.

The second C of employee engagement refers to 'Connect', which stresses the importance of strong workplace relationships. Organizations are social systems and comprise of both formal as well as informal relationships. Informal relationships have a stronger impact on employees and provides them motivation to perform their functions effectively. A popular study reveals that employees who have a best friend at workplace tend to be seven times more engaged than rest of the employees. Creating a collaborative atmosphere helps in enhancing communication and which in turn helps in building stronger workplace relationships. Emotional Intelligence plays an important role in building and sustaining relationships at work. Relationship building and sustenance is even more difficult in case of virtual work teams and remote working. Online meetings, virtual chat groups and Social Walls could help developing teamwork and collaboration among the employees. The Harvard Business Review identifies 12 elements of EI categorized into four of its components.

(i) Self-Awareness: Emotional Self awareness
(ii) Self-Management: Emotional Self-control, Achievement Orientation, Adaptability, Positive Outlook
(iii) Social Awareness: Empathy, Organizational awareness
(iv) Relationship Management: Coach and mentor, Influence, Conflict Management, Teamwork, Inspirational Leadership.

'Coaching' is the third C needed for engaging employees proactively in an organization. Employees would like to work for an organization which goes beyond extracting work from its people. They refer an organization that focuses on investing in its workforce, investment in the form of training and development programs, career advancement opportunities and helping employees to reach their maximum potential. If employees are guided and helped in shaping their career and future work life, they tend to develop higher levels of commitment towards the organization. Organizations must adopt 360° feedback and conduct ongoing programs to recognise and appreciate employee performance and assist in career growth.

The 4th C in employee engagement is 'Contribute'. Employees want to feel valued in the organization, they want their efforts to have long lasting impact on the organization. It is important to align individual goals with the goals and mission of the organization. Employees must be encouraged to participate in decision making and image building of the organization. They must feel recognised and important in the place they work. Hence, engaging employees in CSR activities can be an effective tool to strengthen employee commitment.

The last and most important C in employee engagement is 'Congratulate'. Employees look forward to being recognised and applauded for their efforts and ideas. Increase in salary by way of increments might not be possible for organizations working on a tight budget, however appreciations and praises are budget free, they do not involve any cost. The managers and leaders must recognise and praise the effort and performance of their team members. Timely recognition and appreciation go a long way in enhancing employee satisfaction which is extremely essential for improving employee engagement. Creating a positive culture and celebrating success and achievements would lead to a stronger and engaged workforce.

Employee Engagement initiatives are usually part of a broader scheme designed to help develop staff, improve their performance, and keep them happy and engaged at work. Engaged Employees display a stronger sense of loyalty and commitment and perform better in their work. Effective Employee Engagement helps in creating a healthy organizational culture which strives on teamwork and strong employee relations. Enhanced employee engagement helps to reduce staff turnover, increase productivity, build better work and customer relationships, and impact company profits.

Employee Engagement initiatives are diverse starting from individual activities to team and group-based activities. Most organizations include fun and leisure-oriented activities as part of Employee Engagement. These activities could be Festival and Birthday Celebrations, Sports and Gaming events, Outings and Get Together, and many more such fun filled events. The type of activities conducted for engaging employees would depend on the demographic composition of the workforce. Understanding the likes and dislikes, interests and expectations of employees would help in designing suitable and engaging activities.

Corporate Social Responsibility: Corporate Social Responsibility is a management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders. The origin of the concept of CSR can be traced back to the 1930s. CSR is defined as "A Company's commitment to manage the social, environmental and economic aspects of its operations responsibly and in line with public expectations". The main aim of CSR is to give back to the community through philanthropic endeavours and create positive social value. Business Enterprises are increasingly focussing their attention on CSR to build a positive brand image. CSR is also known as Corporate Citizenship and the beneficiaries of CSR could be Employees, Customers, Suppliers, Environment and Society at large.

Corporate social responsibility is traditionally broken into four categories: environmental, philanthropic, ethical, and economic responsibility. This is based on the 4-stage model referred to as the 'Carroll's Pyramid' which suggests that companies start with their economic social responsibility, then move on to Legal social responsibility, then to Ethical social responsibility and last to Philanthropic social responsibility. After a few years, a three-domain model of CSR was proposed consisting of Economic, Legal and Ethical responsibility. Philanthropy was assumed to be a part of all the three categories.

Economic Responsibility in CSR refers to running business in a profitable manner by providing jobs and catering to the needs of all stakeholders. By fulfilling this responsibility, a business will be able to enhance its goodwill, trustworthiness, reputation and gain competitive advantage. Legal responsibility in CSR refers to being law abiding and carrying out business by complying to all the relevant legislations and regulations. This implies that an organization must not indulge in illegal, corrupt, and fraudulent practices in order to gain economic advantage.

Ethical Responsibility in CSR involves doing what is right, fair and just, even when it is not enforced by law. This indicates the commitment of an organization to behave what is expected by society even though it is not required by law. Philanthropic Responsibility involves contributing voluntarily to the community and help in improving quality of life. This can be done by direct donations or supporting an NGO involved in a social mission or cause.

Many organizations have created customized CSR models to suit their corporate culture and values. Coca Cola is famous for implementing a 5 * 20 CSR Model which focussed on employing 5 million women in developing countries by the year 2020. This aimed at supporting women empowerment as well as community development. Salesforce created a 1–1–1 CSR model which aimed at giving one percent of product, one percent of their profits and one percent of their employee's time to community. The Tata Group through its CSR aims at enabling Communities by making them self-reliant.

Organizations can show CSR in many ways, including in the form of donations to charities, employee volunteering, environmentally conscious production processes, fair trade practices, ethical labour practices, implementing green practices, reducing carbon footprints, promoting diversity, equality, and inclusion, and more. The basis of CSR is to strike a balance between social, economic, and environmental commitments. The CSR strategy must rest on the three Ps namely People, Planet and Profit. Research undertaken by NEEF (National Environmental Education Foundation) found that 90% employees who are engaged in a company's CSR activities feel more satisfied towards their job and work life. It also stated that 25% of employees had a Zero tolerance policy towards organizations that were following unethical practices. These numbers indicate the importance and relevance of adopting CSR initiatives.

India, on April 1, 2014, became the first country to make Corporate Social Responsibility a mandatory provision under Section 135 of Companies Act 1956. The Act makes it mandatory for companies to spend a minimum of 2% of their net profit towards social causes. The companies recording a profit of five crore are more come

under the purview of this act. The companies could contribute the CSR fund through a non-profit organization or through its own foundation. Books of accounts related to CSR contribution and spending must be maintained and audited from time to time.

Generation Z: People born between 1997 and 2012 are termed as Generation Z or 'Zoomers'. The current entrants to the workforce are termed as the 'Gen Z' and are also called as the 'Internet Generation'. They succeed the Millennials, who are people born between 1981 to 1996 and are in between Generation X and Generation Z. Workforce was until recently dominated by Millennials who are hardworking and value loyalty. The Generation Z has now taken over the workforce with their tech savvy approach and will soon become the largest cohort of consumers. The Generation Z employees are smart workers and well versed with all aspects of technology. They are born in the internet era, hence are driven towards remote working. Gen Z employees pose to be a big challenge for HR managers and to manage them it is important to understand their habits, likes and digital expectations.

An important characteristic of Generation Z is that they can multi-task and have varied hobbies. Their familiarity with technology and sophisticated gadgets indirectly affects their personality. Studies suggest that Generation Z prefers transparency, independence, flexibility, and personal freedom at work. If an organization ignores them, it could bring in frustration which would in turn reduce productivity, low morale, and lack of employee engagement. Generation Z employees value honesty and integrity in their leaders and look for transformational leadership at workplace. Gen Z employees prefer to make their presence felt and go beyond the regular work-life commitments. They are aware about social issues and want to contribute their share towards betterment of society.

Literature Review

A lot of work has been brought out in the field of Corporate Social Responsibility and on Employee Engagement Strategies. However, there is very limited literature which talk about the integration between the two concepts, i.e. integrating Employee Engagement practices with CSR. Some of the researchers who have dealt with this topic are mentioned below.

Glavas (2016) The researcher suggests that CSR should be more individualized and personal. Most of the companies have a generic and common strategy for implementing CSR in the entire organization. However, the findings of the study specify that CSR can have far reaching impact and affect employees at an emotional and personal level. CSR helps in connecting with the core values of an individual and provide wholesome satisfaction and make life more meaningful. The concept of Organizational Behaviour rests on the concept of Individual Differences. Keeping this concept, every individual is different and hence derives satisfaction based on individual values and expectations. In order to be effective, CSR should be individualized and cater to the concept of individual differences.

Mirvis (2012) This researcher in his study talks about the connect between CSR and Employee Engagement. If employees are made to involve in CSR activities undertaken by the company, it could have a positive impact on employee motivation and their mental well-being. The researcher speaks about the three approaches to CSR and employee involvement. The first approach is known as a Transactional Approach, in which the organization conducts CSR activities keeping employee interest in mind. Hence, employees can involve in these CSR activities and feel engaged. The second approach is termed as the Relational Approach which aims at identifying and catering to the psychological needs that revolve around social responsibility. This makes the employees develop a stronger connect with the organization. The third approach is known as a Developmental Approach, which focuses on a bigger picture of turning employees into responsible corporate citizens. This approach is a long-term approach and aims at bringing a change in the behaviour and mindset of the employees. The approach chosen by the organization would depend on the interest, involvement, and maturity level of its employees.

Carr (2018) The researcher is of the opinion that an organization must integrate its CSR strategy with its employee engagement strategy in order to enhance participation and success. Designing a CSR Strategy keeping employee interests in mind would help in making it more effective and sustainable. The focus of CSR strategy must be on employee interest and their involvement. The organization must ensure the employees feel connected with the CSR objectives of the organization and it instils a feeling of pride and achievement. The organization must not just communicate the CSR efforts with employees. They must design comprehensive CSR initiatives to ensure there is proactive participation from employees, and at the same time there is learning and knowledge creation.

Mohammed (2019) The researcher through his study highlights that each generation of employees must have different levels of engagement. This engagement level is based on work ethics, work environment, and individual interest levels. If an organization is able to identify the driving force behind employee engagement, it can come up with initiatives that would help in creating an engaged and committed workforce. The typical characteristic of Generation Z is that they are individualistic and prefer to do what they like. They tend to break away from the norms and like a sense of autonomy. There is also a perception that Generation Z employees are risk takers and do not like to work in the same organization for a longer period of time. They tend to change jobs frequently and lose interest and focus if the job is not challenging enough. Engaging the generation Z employees would be crucial for the success of an organization.

Tobias and Garima (2023) present the reasons and factors that make employees disengage themselves with the CSR initiatives that they do not relate to or agree to. Corporates are in tremendous pressure to associate themselves with a social cause and to make this association a successful one they require the active involvement and participation of their workforce. The engagement must be from all employees working at all levels. There are times when the employees do not connect with the CSR goals and activities and hence, they tend to display disengaged behaviour. The CSR—employee engagement can be categorized into four stages namely, Paralysis,

Disconnection, Negotiation and Proactivity. These stages of engagement will depend on how much an employee connects or relates to the relevance of CSR activities undertaken by the organization.

Linking Employee Engagement with Corporate Social Responsibility *Initiatives*

Motivation levels and Employee Engagement are considered as major indicators of organizational effectiveness. Employee Engagement is viewed as a two way mutual understanding between the organization and its workforce. Employees feel a sense of belongingness towards the organization that they work for and on the other hand the organization and management feel a sense of responsibility towards its employees. Employee Engagement stands on the two pillars of Information and Interaction. Employees must clearly understand the vision and mission of the company, the goals that lie ahead and the strategies adopted to achieve them. There must be active involvement of employees in decision making and in spearheading CSR initiatives. This however seems easier said than done.

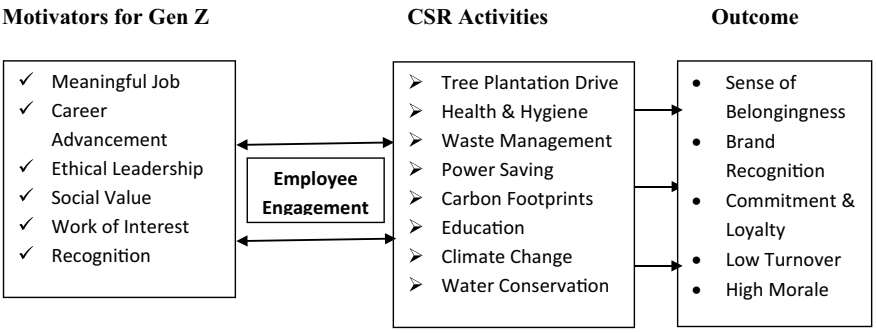
Employee Engagement has been a major area of concern for organizations worldwide. Research conducted by Gallup shows that only 36% of the global workforce is effectively engaged. The report further states that 13% of the global workforce is actively disengaged. This disengaged workforce in the USA alone costs the companies 450–550 Billion USD every year. Gallup's Report on Employee Engagement shows that companies with a highly engaged workforce have 21% higher productivity. They also have 17% higher productivity than companies with a disengaged workforce.

The Deloitte Global Millennial Survey 2020 which focuses on the feedback of Millennials and Gen Z reveals that resilience and determination of the younger generations will surely shape the world that emerges. The Survey was carried out on 9,100 individuals which included 5,500 Millennials and 3,600 Gen Z employees spread across 13 countries. 79% of respondents belonging to Gen Z agreed that climate change is caused primarily by humans and recognized the importance of protecting the Earth. Approximately a fifth of millennials and Gen Z's claimed to be vegetarians or vegans, and 40% of millennials reported reducing their consumption of meat and fish. The survey also revealed that the Millennials are willing to engage themselves in CSR activities so that they could add value and contribute to the society.

A number of psychology experts have identified unique characteristics in the Generation Z workforce. Generation Z employees are purpose driven, technology wizards, well spoken, well read, and well connected. Their expectations from work and employer are far different then the Millennials and Generation X employees. They are willing to take up challenging work roles and go beyond the call of duty. They want to add value to work and society through their efforts. The Generation Z employees are risk takers and prefer to tread the path less visited by others. They

choose satisfaction over money; they choose passion over career. They believe in the 'YOLO' (You only live once) concept. They tend to break away from norms and seldom value criticism and backlashing. This generation is not driven by job security, they are driven by assignments which make them contribute to a better society and a better world. Hence, it is essential to engage these Generation Z employees in activities that would cater to their needs and interests. Keeping the motivators in mind, a Model integrating Employee Engagement and CSR could be developed to engage and retain Gen Z employees.

EE-CSR Model for Gen Z



The EE-CSR Model for Gen Z talks about the three aspects namely Identifying Motivators, Linking CSR activities with Employee Engagement and evaluating the outcomes. The first level would be to understand the factors that motivate and drive Gen Z to work in an organization. The Gen Z gives a lot of importance to the job and the satisfaction they derive from it. Having challenging assignments and getting timely opportunities for advancement can boost the motivation of Gen Z employees. The Gen Z employees give a lot of importance to the nature of job and the ultimate value that they are able to bring in. They also are driven by ethics and moral codes and want to give back to society in their own little ways.

Keeping these motivators as guiding forces, an organization can identify the activities which it could choose to contribute towards societal value. The employees must be proactively engaged in these activities so that their interests and energies are channelized in the right direction and the employees can work towards achieving individual goals. The activities chosen for CSR must be centred around social issues and help in delivering service to society at large. The CSR activities must be such that the Gen Z employees participate proactively and feel valuable. Climate change has been the buzz word in today's scenario. The CSR activities could be built around this theme. Activities such as Cleanliness Drive, Car Pooling, Waste Management, Rain Water Harvesting, Tree Plantation Drives, E-waste disposal, Reduction of Plastic consumption, etc. could be undertaken with the involvement and participation of the Gen Z employees.

Engaging employees in CSR activities can result in both individual as well as organizational outcomes. From employee point of view, this integration can improve

work satisfaction and motivation levels on one hand and on the other hand it would strengthen teamwork and camaraderie among employees. It would also uplift the morale of the workforce and develop a sense of belongingness among the employees. From the organizational perspective, this integration and linkage could reduce attrition rates and improve loyalty and commitment towards the organization. This integration can enhance the brand name of the organization and give returns both in terms of higher profitability and market share. This will also help the organization to attract talented workforce and bring stability in people management.

The above model is simplistic and can be implemented easily in any form of organization. For a successful implementation of this model, it is important that the HR Manager must share information with all employees. Suggestions must be invited form the employees with regard to the issue to be chosen and the activities to be conducted to address the issue. There must be clarity both in terms of goal of the CSR activity and the target group. The budget and the plan of spending must also be carefully planned and discussed with the team members. Employee participation is paramount for the success of CSR programs.

There could be limitations in terms of resistance from management as well as employees while planning and executing CSR programs involving employees. The management would be hesitant to invest in CSR activities and would be doubtful about its positive impact on business. At the same time, some of the employees might find it as an additional burden on them apart from their routine work. Hence, it is extremely important to plan and execute the CSR program by integrating and garnering the support of all the stakeholders.

The responsibility of this integration lies with the HR Heads who need to be proactive and coordinate with all other Department heads and ensure all are on the same page. Social Media can be effectively used to share the CSR goals and activities planned. This is an effective platform to engage the Gen Z employees. It would also have a positive impact on the brand image of the organization.

The above model results in a win–win situation, as employees will be happy and motivated and at the same time the organization can also deliver its responsibility towards society. This linkage and involvement of employees in CSR activities could be a potential differentiator and a source of competitive advantage. This could also prove to be a sustainable business practice which could benefit all three stakeholders Customers, Employees and Society.

The study by Harvard Business School suggests that 90% of employees who work with socially responsible organizations tend to show higher levels of employee motivation and morale. Success of CSR rests on the shoulders of both employer and employees. The investment made in planning and implementing CSR in terms of money, time and effort would not deliver the desired outcomes unless it is supported by employees. Organizations could adopt the following strategies to integrate Employee Engagement Practices with Corporate Social Responsibility initiatives.

First and foremost, the organization must understand the value system of its employees. This must be integrated and aligned with the Organizational value system. Understanding employees must begin from the recruitment stage. The HR department

must make it mandatory for all employees to highlight their societal responsibilities in their resume. The CSR initiatives that are planned in the organization must align with the areas of interest that employees have mentioned in their resume. When the CSR initiatives are in line with employee interest and liking, then the success of the campaign is guaranteed. The Gen Z workforce is very clear about what they like and what they want to be engaged in. So, planning CSR initiatives keeping in mind the interest and motivating factors would derive benefits for both organization and employees.

The second important aspect is to have a robust communication system. Every employee must be aware about the CSR activities that the organization is involved in. They must know the initiatives that the organization has planned and implemented as part of its CSR and how employees' cut becomes a part of this. Promoting the CSR initiatives among employees and within the organization is extremely essential to get support and involvement of employees. Fierce internal communication campaign must be launched in educating employees about the CSR initiative and how they could pitch in both in terms of financial contributions or their efforts and participation as Volunteers. Social Media handles could be used to circulate information related to CSR activities. Generation Z employees tend to actively follow and are influenced by social media trends.

Incentivizing employee participation in CSR activities is yet another way of creating employee engagement. The organization must bring in a system of identifying and recognizing employees who have shown proactive participation in CSR activities. They must be allowed time off from work to carry out CSR work. Fun incentives like special gifts, free lunches, could also help in developing employee interest towards CSR. The Generation Z employees prefer to live in the moment and hence, these fun activities could prove to be a morale booster for them.

CSR must be incorporated into the business processes for it to be effective and engaging. It should not be seen as a burden or an 'add on', instead must be interwoven with the work processes and work culture. The organization must be committed towards making a difference in the society it works in. This commitment will percolate down the line and will also motivate employees to join the journey of making a better society. The Generation Z in particular is very keen on knowing the ethical and social side of a business enterprise. They prefer to associate themselves with an institution which is socially, ethically, and environmentally responsible.

While integrating CSR with employee engagement, the employers face numerous challenges. The first being creating an alignment between CSR initiatives and business strategy. The second challenge would be to communicate and convince the employees and stakeholders about the purpose, utility, and value of CSR activities. The third constraint would be to balance time and effort between CSR activities and operational commitments. Giving employees time off from work to take part in CSR activities would mean compromising on the financial bottom line. The other challenge would be to measure the impact of employee engagement in CSR activities.

These challenges can be overcome by following a systematic and strategic approach to engaging employees in CSR initiatives. Alignment between Corporate mission, vision, CSR goals and individual goals is essential. Regular and transparent

communication on the planning, implementation, and outcome of CSR initiatives is a must. Collaborations with external agencies and experts could help in bringing innovative ideas that could drive this integration forward. The CSR initiatives must be local and employees must be able to connect with the issue chosen by the company. Involvement of employees at all stages of the CSR program is a must to ensure its success. Timely recognition and incentives to the employees who are proactively engaged in CSR initiatives would pave the way for successful conduct and management of CSR in the organization.

Conclusion

Employees belonging to Gen Z form a dominant part of the workplaces today. The personality traits of Gen Z are very different than those seen in Millennials and Generation X. Hence the organization must carve a well thought strategy to engage, motivate and retain them. CSR activities are a major determinant of an organization's style of working and its commitment to society. When employees feel that their organization is socially responsible, they experience a greater sense of identity with the business they work for. This increased identification will mean employees are happier to be on the job and will feel a deeper connection to the work they're doing.

Linking employee Engagement with CSR initiatives would have long term benefits in terms of talent attraction and retention, work life balance, brand equity and employee satisfaction. This linkage would help in creating a competitive advantage for the organization. It is important not to see CSR as an end goal, rather it must be viewed as a journey, which leads to creation of a corporate culture resting on the foundations of service and society. Companies have begun to realize that engaging in CSR not only has a positive impact on society but also helps in creating and maintaining a motivated, energized, and loyal workforce.

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Profitability Analysis of Selected MNCs in Indian Cement Industry During the Post Liberalisation Era

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Abstract Any business's main goal is to maximize profitability. Analysis of profitability is the process of assessing a company's capacity to make a profit using financial metrics like revenue ratios and margin ratios. To ascertain how effectively a company is turning a profit, it involves looking at both operating costs and sales revenue. Companies can monitor their progress by calculating and comparing profitability ratios from various time periods. Profitability ratios quantify and assess your company's potential to turn a profit relative to its costs and revenues over a specific time frame. A company's ability to produce revenue as well as value for shareholders can be demonstrated by analysing its earnings ratios. A company is more profitable and more desirable to investors when the ratio is higher. Profitability analysis examines the current financial situation to assist businesses in deciding on upcoming plans, financial commitments, and the company's success. Using profitability analysis to inform important business decisions looks like this GPR, NPR, OPR, ROCE, RONW etc. Gross profit margin aids in determining whether a company is making enough money from its sales. Businesses can use profitability analysis to calculate the earnings or return proportion that they must pay to their stockholders. It also helps prospective investors make investment decisions by providing them with information about a company's financial situation. A smaller margin of gross profit means that the company must make expense reductions. This paper aims to shed light on the profitability trends among India's top 15 cement producers. Additionally, it tries to track and evaluate the industry position of other firms. The profitability metrics are given ratings and placed inside a predetermined range for comparison how they have performed. The cornerstone of the research was its secondary information, which was collected from published yearly reports during a span of ten years (2014–2023). The relevant data have been reviewed using statistical methods such as Mean, SD,

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and Rank, along with substantial ratios of profitability with the assistance of the R programming.

Keywords Cement industry · Profitability · Substantial ratios

Introduction

One of the most important industries in the world is the cement sector in India. It took 120 years for it to get there. The cement industry's journey began almost 100 years ago. In 1904, it was first started in Chennai, Tamil Nadu. However, this effort was unsuccessful, and Portland cement made a significant market entry in 1913–14. The cement business grew because of the outbreak of the First World War. In 1922–23, six new plants with a 5.59 million-ton production capacity were put into operation. Several plants were established in Punjab, Tamil Nadu, and Bihar between 1934 and 1937. England had to supply cement to India at that time. Cement that was imported and costed more money. Other factors that contributed to the industry's quick rise to prominence in India included an increase in domestic demand, the availability of capital, an abundance of raw materials followed by a decrease in foreign supply due to the war, affordable labour, government support, etc. Then, as part of the economic liberalization strategy, the industry was delicensed in July 1991. The government hoped to spur further modernization and expansion investments by eliminating all restrictions on the cement industry.

We are behind China in the global cement production rankings for a good reason. The amount of cement consumed per person has decreased over the past ten years. China currently consumes 1380 kg of cement per person, whereas India has lagged with only 230 kg. Over the past two decades, the Indian cement sector has seen every phase of the standard periodic growth process. The industry is currently in a phase of consolidation following a period of oversupply and a phase of significant capacity additions. The demand for cement is increasing because of sound economic expansion and the expansion of infrastructure. To meet the growing demand for cement, more capacity expansion is planned. India is the world's second-biggest manufacture of cement, behind China. It produced 142 mt in 2006 with a capacity of 160 mt. India consumes 125 kg of cement per person annually, which is only about a third of the global average. It shows the industry's potential for growth. The economy's state of development and rate of expansion have a significant impact on cement demand. Cement production increased after deregulation, from 23.5 mt in 1983 to 44.1 mt in 1989 to 142 mt in 2006. The cement industry had a 160 mt. installed capacity as of March 2007, but only 83% of that capacity was being used. India is expected to generate 550 million tonnes of cement by 2020, up from 300 million tonnes in 2010. The manufacturing of cement has increased from 106 million tonnes to 300 million tonnes in the last ten years that's more than double.

The infrastructure sector, particularly roads, has benefited from the Union Budget 2016–17, which will eventually affect the nation's cement industry. The Indian

government included USD 8.22 billion in the budget for the construction of Indian roads and highways, which will support the country's cement industry. The construction sector in India accounted for over 67% of the nation's overall cement consumption and is believed to be an important contributor of cement industry development in the country (Source: Emkay Global Financial Services, Union Budget 2016–17). In addition to allocate Rs. 10 lakh crore for expenditure on capital in the Union Budget 2023–24, the Centre has significantly increased the infrastructure through megaprojects like the ambitious Bharatmala Pariyojana, Sagarmala Project, Smart Cities Mission, AMRUT (Atal Mission for Rejuvenation and Urban Transformation), and PMAY (Pradhan Mantri Awas Yojana). These programmes show how serious and committed the government is to be boosting economic growth, enhancing connectivity, generating employment opportunities, and generating large sums of money. Due to growing demand for housing and infrastructure, national production of cement rose from 296 million tonnes in the financial year 2021 to 356 million tonnes in the year 2022. Cement consumption was 355.46 million tonnes in the financial year 2022 and is expected to increase to 450.78 million tonnes in the fiscal year 2027. Numerous studies on various aspects of corporate sector profitability in India have been conducted. To pinpoint the gaps in the literature, some of them that stand out are reviewed. According to Banerjee's research (1982), Liquidity affects company profitability in three keyways. Up to a certain degree, increased liquidity increases profitability; after that, it remains steady with increased liquidity until intermediate point; and lastly, increased liquidity causes profitability to decline.

Cost components were thought to be the most significant predictor of profitability after conducting econometric research of price–cost margin in Indian manufacturing businesses. The study found a significant correlation between operating long-term asset turnover ratio and profitability. The ratio of accounts receivable to total revenue was favourably correlated with 19 of the 20 enterprises. Inventory turnover ratio was favourably connected with profitability in 14 businesses with 51 profitability among 19 businesses out of 25.

Chakraborty (1976) investigated the link between the amount of working capital and earnings at 25 selected Indian pharmaceutical enterprises from 1996–1997 to 2007–2008. The study found that management of inventories, credit, and liquidity all positively correlated with higher business profitability. Basu (1992) examined the relationship between customers' management and profitability in his study, utilising information from eleventh carefully selected cement sector companies in India between 2000 and 2009. The study discovered a positive correlation between return on capital employed in nine distinct organisations and the current ratio, turnover of inventory ratio, and debtor turnover ratio. Seven other organisations found a positive correlation between the inventory turnover ratio and return on capital employed. In 2012, Sathya conducted a study analysing the overall profitability index of thirty cement companies in India. For this investigation, the researcher employed secondary data, which she subsequently examined using an array of statistical instruments and techniques. The report states that the selected organisations were ranked based on composite profitability by combining ratio-wise results. The company that had the highest overall score was ranked first, while the company that received the lowest

overall score was ranked last. India possesses the second biggest cement producer globally. The world economy's biggest sector is cement. Between 2000 and 2014, it garnered US $3,084.89 million in foreign direct investment (FDI) to assist the housing, infrastructure, and employment sectors. It is projected that the manufacturing capacity will reach 550 MT by the 2020 fiscal year. The study paper's primary focus is on studies of the earnings of a few chosen Indian cement companies between 2005 and 2014. The analysis tools included the mean, standard deviation, coefficient of variation, and annual compound growth rate. Comparing Ambuja Cement's revenue situation to that of other companies, the study found that it is good.

A few of the Indian concrete businesses' problems and future potential were evaluated by Sasikala and Balakrishnan (2015). This study's foundation was secondary data gathered from industry profiles and cement industry annual reports. A strong tool for identifying issues with an industry's operations and financial position is financial analysis. The business should improve its performance so that it can meet challenges, seize opportunities, and assist management in making financial decisions in the future. The researcher makes recommendations for future improvements to the cement industry considering the findings. This study also identifies the limits to which various industries can improve the accuracy of their assets' positions and financial resources. Raju (2016) provided evidence in his study that investment planning facilitates the examination of proposals for capacity addition or development as well as the decision of whether to devote funds to long-term endeavours. By analysing various capital investment proposals, he was able to select the best option from a variety of alternatives. Objectives of the study is to watch the companies' performance in profitability that are being studied. The study also evaluates the chosen companies' revenue status using widely accepted financial ratios.

Limitations of the Study

The study is only able to analyze data from the 2013–2014 fiscal year to the 2022–2023 fiscal year.

Only 15 cement industries according to market capitalisation were included in this study. As a result, its perspective is limited. The research is predicated on secondary data that was obtained from the company's official annual statement and websites such as Capitaline database. Consequently, the limitations of the study with respect to the secondary data will continue.

Research Gap

The literature review convincingly demonstrates that numerous studies have been conducted on the factors that affect profitability, but there are only a few research papers that address how these factors affect profitability in India's cement industry.

The research paper attempts to fill this gap by analyzing the profitability of India's listed cement companies over a ten-year accounting period, from 2014 to 2023. The expansion and development of the cement industry is a key factor in the India's economic development. Many studies have been done in this area, but only a small number of them have been done in India. Most of the studies that have been done on profitability have been done in other parts of the world. However, none of these studies have given the cement industry a special emphasis.

Methodology

Universe

The universe of the study consists of all the limited cement companies working in India and listed on the stock exchange of India.

Sources of Data

The necessary information for this study was gathered from secondary data sources found on the websites of the chosen cement businesses, including their annual reports and statements of finances. The data was extracted from the top fifteen companies in the CEMENT sector belonging to the "BT 500 India's Most Valuable companies" according to market capitalisation published by the "Business Today" in 2023. Additional sources from which the data was gathered included the Capitaline Corporate Database (CMIE), Capital Market Publishers(I) Ltd. (Mumbai), CMIE Reports, Screener.com, books, magazines, journals, newspapers, research reports, and websites.

Sample Size

The top 15 Indian cement companies are selected based on market capitalisation as of 31st March 2023.

Study Period

The study is planned for ten years, from 2013 to 14 through 2022–2023.

Sampling Techniques

Purposive or judgemental sampling technique is followed in the study. Here financial performance will be considered as dependent variable and liquidity, profitability and efficiency will be considered as independent variable.

Data Analysis

Evaluation of the Chosen Companies' Profitability

Profitability is the capacity of a company to turn a profit. The two distinct categories of profitability ratios are profit margin ratios and rate of return ratios. Profit margin ratios show how revenue and earnings are related. Because profit can be evaluated at different stages of the process, there are several kinds of profit margin ratios. The most popular profit margin ratios are the gross profit ratio, net profit ratio, and operational profit ratio. Ratios of return illustrate the relationship between investment and profit. The most popular rate of return measurements is return on net worth, return on capital employed, and others. The following metrics of profitability are used in this chapter to analyse the profitability of the businesses that have been chosen.

Gross Profit Ratio (GPR)

The amount of profit made in relation to sales revenue is measured by the gross profit margin. This shows the profits a business makes after subtracting the expenses related to producing its goods and services. Because core operations can still generate net profits for the company while paying for operating expenses, fixed expenses, dividend payments, and depreciation, a large gross profit margin ratio suggests that these activities are more efficient. Conversely, a low profit margin indicates a high cost of items supplied, which may be caused by bad tactics for promoting sales, low selling prices, disadvantageous purchasing practises, or a highly competitive market.

The average GPR and C.S. of the chosen companies in the Indian cement industry from 2013–14 to 2022–23 was 46.22 and 7.99, respectively. According to the study of GPR of the chosen companies, eight of them—Ultratech, Grasim, Ambuja, Shree, ACC, Dalmia, India, Star, and Orient—maintained their production and pricing efficiency at a level higher than the industry mean (46.22) during the study period, while the consistency in this area was significantly higher in these companies than it was for the industry C.S. (7.99). Thus, the cement industries of Ultratech, Ambuja, Shree, and Orient were finally able to manage both their production efficiency and pricing very effectively (Table 1).

Table 1 Analysis of gross profit ratio of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	44.20	49.57	53.41	51.45	47.82	49.25	51.61	50.80	49.13	46.35	***49.36***	2.71	***18.21***
Grasim Industries	38.66	42.09	45.98	39.57	42.12	42.04	44.08	43.05	40.72	41.18	*41.95*	2.12	***19.76***
Ambuja Cement	45.39	66.34	54.46	55.41	52.67	53.10	56.42	59.23	60.00	58.83	***56.19***	5.54	***10.15***
Shree Cement	44.25	53.69	60.41	56.88	53.49	58.02	60.09	54.95	51.24	52.03	***54.51***	4.81	***11.34***
Acc Cement	40.27	50.19	51.07	51.71	51.27	51.87	52.13	51.06	26.56	47.42	***47.36***	8.13	*5.82*
Dalmia	84.51	51.55	57.92	56.58	53.03	55.90	36.43	61.89	55.26	50.80	***56.39***	11.97	*4.71*
JK Cement	43.21	48.12	51.79	50.45	45.99	47.41	48.34	37.32	43.51	44.74	*46.09*	4.17	***11.06***
Ramco Cement	18.89	26.82	34.46	28.62	26.25	31.31	55.67	54.47	47.53	43.85	*36.79*	12.77	*2.88*
Nuvoco	37.17	42.65	50.50	25.67	20.07	46.12	48.41	26.30	49.14	60.84	*40.69*	13.07	*3.11*
JK Lakshmi Cement	21.76	21.97	25.00	24.35	40.03	41.81	42.46	40.81	42.59	41.50	*34.23*	9.51	*3.60*
India Cement	80.20	41.58	48.67	44.88	43.00	46.84	50.94	49.87	48.13	46.10	***50.02***	11.00	*4.55*
Star Cement	76.87	41.98	43.82	46.88	50.21	56.44	52.06	56.27	60.46	59.25	***54.42***	10.10	*5.39*
Heidelberg	82.08	37.87	43.48	44.56	43.30	41.10	37.96	39.61	40.14	33.29	*44.34*	13.67	*3.24*
Orient Cement	47.75	57.44	58.50	52.73	54.20	52.66	47.55	48.88	52.13	48.01	***51.99***	3.96	***13.13***
Sagar Cement	13.31	22.19	33.06	19.66	15.55	41.40	36.06	35.85	35.68	37.00	*28.98*	10.20	*2.84*

(continued)

Table 1 (continued)

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Cement industry											**46.22**	**8.25**	**7.99**
Below industry average			***Above industry average***				Highest value			Lowest value			

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

Net Profit Ratio (NPR)

The bottom line of the company is the net profit margin. It looks at the net earnings and divides it by the total sales for a business. It shows the profitability of a business after all costs, such as taxes and interest, have been subtracted. The fact that the margin of net profit accounts for everything makes it a useful metric for gauging profitability. This metric's drawback is that it contains a lot of "noise," such as gains and one-time expenses, which makes it hard to accurately compare the performance of an organisation to that of its rivals.

During the years 2013–14 to 2022–23, the average net profit ratio (NPR) of the chosen cement companies in India was 7.06, while their average consistency score during the same comparable period was 1.96. According to the NPR analysis of the chosen companies, seven businesses—Ultratech, Grasim, Ambuja, Shree, ACC, Ramco, and Star Cement—maintained an overall level of effectiveness in production, administration, selling, financing, pricing, and tax management during the investigation period, above the industry mean of 7.06. Additionally, the businesses' consistency in terms of effectiveness in production, administration, and selling, financing, pricing, and tax management was significantly higher than that of the industry (1.96) during the same study period. The total production, administrative, selling, finance, pricing, and tax management efficiency of the cement industries—Ultratech, Grasim, Ambuja, Shree, ACC, Ramco, and Star—was confirmed to be encouraging and satisfactory (Table 2).

Operating Profit Ratio (OPR)

Before deducting interest and taxes, the margin of profit from operations expresses income as a percentage of sales. Businesses that have large operational profit margins are typically better able to cover fixed costs and interest on debt, are more likely to weather economic downturns, and can offer cheaper prices than their less profitable rivals. A company's margin of operation is sometimes used as a proxy for management strength since effective management can increase profitability by controlling operating costs.

During the years 2013–14 to 2022–23, the average operating profit ratio (OPR) of the chosen cement companies in India was 11.64, while their average consistency score during that same period was 2.77. The study of OPR of the selected companies shows that as compared to the industry mean (11.64) the operating profitability of eight companies, such as Ultratech, Grasim, Ambuja, Shree, JK, Ramco, Star and Heidelberg cement industries was higher during the study period whereas regarding the consistency of the operating profitability Ultratech, Grasim, Ambuja, Shree, JK, Ramco, Star and Heidelberg were placed in a better position as compared

Table 2 Analysis of net profit ratio of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	8.02	13.94	12.21	13.55	5.77	7.18	10.69	9.86	8.64	10.22	***10.01***	2.69	***3.72***
Grasim Industries	9.42	11.71	9.14	9.73	3.56	6.60	11.77	10.02	7.39	9.72	***8.91***	2.48	***3.60***
Ambuja Cement	7.77	12.74	12.81	12.67	10.27	11.42	7.69	6.25	7.49	13.20	***10.23***	2.69	***3.81***
Shree Cement	7.11	15.57	16.89	12.00	8.09	14.08	15.58	20.73	6.61	13.37	***13.00***	4.60	***2.83***
Acc Cement	3.99	3.73	11.54	10.37	8.80	10.27	6.96	5.99	4.88	9.80	***7.63***	2.89	***2.64***
Dalmia	3.84	6.20	12.40	1.11	−0.36	2.22	−2.08	7.25	2.18	−0.24	*3.25*	4.34	*0.75*
JK Cement	4.31	8.50	10.64	8.33	5.01	5.88	4.28	1.26	4.17	2.68	*5.51*	2.88	*1.91*
Ramco Cement	4.19	14.87	14.43	11.21	9.83	12.67	16.49	14.83	6.67	3.11	***10.83***	4.75	***2.28***
Nuvoco	3.77	0.72	0.37	3.48	−0.08	2.21	3.24	3.87	9.65	12.97	*4.02*	4.18	*0.96*
JK Lakshmi Cement	5.45	8.81	8.91	5.80	0.94	1.16	2.99	0.16	4.55	4.51	*4.33*	3.08	*1.41*
India Cement	−3.03	1.36	4.62	1.03	0.44	1.34	3.05	2.38	−0.02	−4.77	*0.64*	2.77	*0.23*
Star Cement	9.15	11.11	10.88	15.59	16.66	20.82	13.15	8.12	8.48	−0.34	***11.36***	5.77	***1.97***
Heidelberg	4.43	10.96	14.77	12.36	10.34	7.01	4.43	2.12	1.66	−3.35	*6.47*	5.64	*1.15*
Orient Cement	3.91	8.54	8.30	3.33	1.78	1.87	−1.55	3.97	12.22	6.88	*4.93*	4.05	*1.22*
Sagar Cement	2.04	6.63	13.74	4.07	2.95	6.60	2.29	7.93	6.41	−5.47	*4.72*	4.97	*0.95*
Cement industry											**7.06**	**3.85**	**1.96**
Below industry average			***Above industry average***				Highest value			Lowest value			

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

to the industry C.S. (2.77) during the same period. So, as a whole in respect of operating profitability Ultratech, Grasim, Ambuja, Shree, JK, Ramco, Star and Heidelberg were placed in the above average category (Table 3).

Return on Capital Employed (ROCE)

Return on capital employed, or ROCE, is a financial term that assesses how well a business uses its capital to make a profit. Put differently, this ratio displays the amount of profit a business makes for every rupee invested. It thereby facilitates the analysis of a business's profitability and capital efficiency. Because the corporation makes more money per rupee of capital invested, a greater ratio is preferable.

Investors with potential may find smart money management to be a rewarding venture because these organisations have made major investments. Due to its capacity to compute profitability following the subtraction of required capital, ROCE is a valuable metric for assessing a business's financial efficiency. ROCE is a useful metric for businesses as well as investors since it enables them to evaluate their operations, pinpoint their advantages and disadvantages, and focus on improving performance. Additionally, since rising ROCE translates into higher long-term profitability, it helps businesses with trend monitoring. During the years 2013–14 to 2022–23, the average return on capital employed (ROCE) for the chosen cement companies in India was 11.29, whereas their average C.S. during the comparable period was 3.07. Only eight companies—Ultratech, Grasim, Ambuja, Shree, ACC, JK, Ramco, Star, Heidelberg, and Orient Cement—maintained their overall profitability while the investigation period at a level above the industry mean (11.29). In contrast, the consistency of overall profitability was significantly higher in Ultratech, Grasim, Ambuja, Shree, ACC, and JK industries of cement in comparison to the industry C.S. (3.07) during the comparable period (Table 4).

Return on Net Worth (RONW)

A profitability indicator developed from the perspective of the investor rather than the business is return on net worth. By looking at this, the investor can ascertain if he would receive the complete net earnings or the amount of return. It describes how stockholders' capital generates profit in an efficient manner. A measure of the profitability of an organisation based on percentages is called return on net worth, or RONW. It is calculated by dividing net income by equity held by shareholders in the company. In finance, return on net worth is used to assess how profitable a business is. It shows the amount of profit a business makes using the capital equity owners have invested. It is also known as return on equity (ROE) as a result.

During the years 2013–14 to 2022–23, the average return on net worth (RONW) and average return on consistency score (C.S.) of the chosen cement businesses in

Table 3 Analysis of operating profit ratio of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	12.44	17.14	19.69	15.70	11.73	13.21	15.79	14.05	13.29	13.41	***14.65***	2.43	***6.02***
Grasim Industries	14.73	17.99	19.39	8.44	13.62	14.95	16.25	13.82	10.92	11.90	***14.20***	3.27	***4.35***
Ambuja Cement	8.48	16.96	17.12	15.03	12.78	10.57	10.50	7.63	8.56	12.97	***12.06***	3.48	***3.46***
Shree Cement	7.28	17.08	20.80	15.19	9.16	16.58	15.29	19.18	6.37	13.38	***14.03***	4.94	***2.84***
Acc Cement	4.66	4.00	14.59	11.25	11.80	9.66	9.63	7.85	5.86	8.06	*8.73*	3.34	*2.62*
Dalmia	7.39	9.50	14.79	5.42	2.43	9.22	11.20	23.64	11.10	8.76	*10.34*	5.75	*1.80*
JK Cement	9.05	15.10	19.08	16.31	11.96	12.79	13.56	8.15	9.67	8.24	***12.39***	3.70	***3.35***
Ramco Cement	8.59	15.05	23.10	15.84	14.74	18.98	23.66	23.43	15.02	8.49	***16.69***	5.61	***2.98***
Nuvoco	−1.28	5.41	9.27	11.41	6.04	9.77	7.87	8.33	7.80	21.54	*8.62*	5.70	*1.51*
JK Lakshmi Cement	8.41	13.06	14.46	12.64	6.12	6.68	7.20	4.34	7.73	7.86	*8.85*	3.35	*2.64*
India Cement	−6.46	5.51	12.14	6.45	6.36	8.29	11.98	11.97	9.30	2.99	*6.85*	5.61	*1.22*
Star Cement	12.47	10.07	10.40	16.42	18.80	24.99	19.08	13.31	14.89	7.50	***14.79***	5.20	***2.84***
Heidelberg	6.10	14.93	19.72	20.39	18.69	14.61	11.65	8.41	12.00	1.48	***12.80***	6.17	***2.08***
Orient Cement	7.28	14.74	16.45	9.83	7.13	8.29	3.32	7.25	16.60	11.12	*10.20*	4.46	*2.29*
Sagar Cement	4.63	13.22	23.68	7.56	6.18	11.76	5.95	11.57	6.97	2.74	*9.43*	6.03	*1.56*
Cement industry											**11.64**	**4.60**	**2.77**
Below industry average			***Above industry average***				Highest value			Lowest value			

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

Table 4 Analysis of return on capital employed of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	12.77	14.62	14.54	11.63	9.92	11.45	13.66	12.88	12.18	13.57	***12.72***	1.47	***8.65***
Grasim Industries	9.04	8.86	8.36	8.14	8.08	9.27	16.37	14.26	11.11	10.91	*10.44*	2.82	***3.71***
Ambuja Cement	10.7	11.8	21.37	17.22	17.2	14.21	14.53	12.34	10.91	18.68	***14.90***	3.61	***4.13***
Shree Cement	8.51	16.54	18.5	14.28	11.59	16.83	17.85	21.24	7.64	15.52	***14.85***	4.39	***3.38***
Acc Cement	7.92	18.75	18.51	14.24	19.05	15.84	15.27	11.02	12.04	14.76	***14.74***	3.62	***4.07***
Dalmia	8.8	6.99	10.48	4.23	2.7	6.93	6.28	9	4.66	3.92	*6.40*	2.53	*2.53*
JK Cement	9.66	15.29	18.26	15.59	11.95	12.64	11.27	7.89	7.52	7.24	***11.73***	3.77	***3.11***
Ramco Cement	6.47	9.4	14.53	12.13	13.45	16.24	18.28	15.35	9.6	5.51	***12.10***	4.25	*2.85*
Nuvoco	1.73	3.87	5.43	8.59	4.86	7.38	5.14	10.1	8.47	15.65	*7.12*	3.90	*1.82*
JK Lakshmi Cement	13.8	17.23	18.09	14.71	6.38	5.77	6.52	4.09	7.63	6.84	*10.11*	5.25	*1.93*
India Cement	−3.8	3.11	6.43	4.22	4.69	5.31	7.41	7.88	6.98	4.62	*4.69*	3.35	*1.40*
Star Cement	17.8	11.2	12.79	16.93	17.75	19.59	13.92	11.49	11.33	4.37	***13.72***	4.51	*3.04*
Heidelberg	10.8	20.28	24.18	26.4	23.67	16.24	10.99	7.41	7.24	1	***14.82***	8.60	*1.72*
Orient Cement	11.57	22.49	18.79	10.88	8.1	8.37	2.9	5.09	15.79	15.52	***11.95***	6.18	*1.93*
Sagar Cement	7.59	11.8	21.55	6.12	5.93	9.62	5.79	12.19	7.76	2.98	*9.13*	5.20	*1.76*
Cement industry											**11.29**	**4.23**	**3.07**
Below industry average			***Above industry average***				Highest value			Lowest value			

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

India were 9.61 and 2.1, respectively. Ten companies—Ultratech, Grasim, Ambuja, Shree, ACC, JK, Ramco, star, Heidelberg, and Orient Cement Industries—achieved gaining capability from their shareholder point of perceptions at a level higher than the industry mean (9.61) during the research period, according to the RONW analysis of the chosen companies. In addition, the consistency of earnings in these companies namely Ultratech, Grasim, Ambuja, Shree, ACC, Ramco and star cement industries was significantly higher than the industry C.S. (2.10) during the same period. It demonstrates that, from the perspective of its equity stockholders, the earning potential of the Ultratech, Grasim, Ambuja, Shree, ACC, Ramco, and Star Cement companies was encouraging fairly and seemed optimistic (Table 5).

Profitability Analysis Using Comprehensive Rank Test

A thorough rank test that considers both the mean and consistency aspects was made to gauge the profitability status of the chosen companies more accurately. Three steps were taken while conducting this analysis. Based on the means of all the chosen profitability measures, comprehensive ranks were determined in the first step. To create a more comprehensive indicator of profitability in this test, the average values of the five specified ratios (GPR, NPR, OPR, ROCE, and RONW) were merged into points score through a ranking process. Greater profitability is indicated by any ratio of profitability with a significant mean value, and that is how the rankings were determined. The driving basis for the final ranking was that a reduction in the aggregate of the individual ranks improves the profitability status in both scenarios.

The consistency of the chosen companies' overall revenue growth was ascertained in the second phase using the comprehensive rank test, which considers C.S. of all the specified profitability ratios of every firm over the research period. A high C.S. of each selected profitability metric suggests a more consistent and beneficial position with respect to profitability, which is why the rankings were done in that order. The guiding concept for the overall ranking was that the position of profitability should be higher than the combined value of the individual's positions, and vice versa.

In Table 8, the ultimate profitability rank is computed by considering both the mean profitability and consistency parameters for the selected companies. The "Ultimate Rank Based on Mean" column shows each company's ranking based on mean profitability measures, with lower values indicating higher profitability. Meanwhile, the "Ultimate Rank Based on Consistency Score" column displays the ranking based on consistency scores, where lower values suggest greater consistency in profitability. The "Sum of Ranks" column presents the total of the ranks from the mean and consistency rankings. Finally, the "Ultimate Profitability Rank (UPR)" column offers a combined profitability rank, taking into account both mean and consistency parameters. Lower values in the UPR column indicate higher overall profitability. Ultratech secures the top spot with a UPR of 1.5, reflecting its high rankings in both mean profitability and consistency. Grasim Industries follows closely with a UPR of 4, demonstrating a strong overall profitability despite a slightly lower consistency

Table 5 Analysis of return on net worth of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	9.69	15.5	13.13	15.8	7.98	8.76	11.71	12.1	10.71	13.62	***11.90***	2.67	***4.45***
Grasim Industries	14.35	15.87	11.44	13.29	7.09	8.31	14.44	13.66	9.91	10.99	***11.94***	2.87	***4.16***
Ambuja Cement	8.48	14.17	15.43	13.27	11.98	13.81	9.61	8.26	6.94	15.22	***11.72***	3.14	***3.73***
Shree Cement	7.03	14.22	16.03	13.52	12.5	16.68	18.41	25.15	8.54	18.4	***15.05***	5.21	***2.89***
Acc Cement	5.65	4.54	13.8	11.8	12.48	15.29	10.18	7.64	8.39	14.36	***10.41***	3.74	***2.78***
Dalmia	3.36	5.53	11.28	1.06	−0.33	2.76	−2.11	6.03	1.77	−0.19	*2.92*	3.90	*0.75*
JK Cement	9.3	16.85	20.79	16.87	11.27	15.5	10.43	3.42	8.08	5	***11.75***	5.62	*2.09*
Ramco Cement	5.07	14.46	14.23	12.67	11.73	14.18	18.88	18.45	9.59	4.66	***12.39***	4.85	***2.56***
Nuvoco	3.62	0.68	0.34	4.85	−0.13	3.45	4.2	8.84	11.8	12.25	*4.99*	4.54	*1.10*
JK Lakshmi Cement	11.8	20.77	22.27	15.95	1.65	1.64	2.87	−1.72	11.05	7.39	*9.37*	8.41	*1.11*
India Cement	−3.03	1.2	3.81	1.18	0.53	1.35	3.08	2.86	0.06	−2.55	*0.85*	2.25	*0.38*
Star Cement	16.92	11.63	12.52	16.05	19.06	25.64	18.25	14.1	13.75	−0.31	***14.76***	6.66	***2.22***
Heidelberg	6.78	16.49	22.43	21.57	19.9	13.23	8.19	4.03	3.24	−4.86	***11.10***	9.08	*1.22*
Orient Cement	7.85	18.6	17.67	7.97	4.58	4.4	−3.17	6.19	21.59	12.74	***9.84***	7.69	*1.28*
Sagar Cement	2.65	8.34	16.99	3.59	3.09	6.14	1.87	9.15	9.21	−10.08	*5.10*	6.99	*0.73*
Cement industry											**9.61**	**5.17**	**2.10**
Below industry average			***Above industry average***				Highest value			Lowest value			

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

score. Ambuja Cement ranks third, balancing performance in both mean and consistency measures. Shree Cement shares the top position with Ultratech, also earning a UPR of 1.5 due to its high rankings in both categories. Acc Cement faces a trade-off between mean profitability and consistency, resulting in a UPR of 7.5. Ramco Cement maintains a strong overall rank, balancing mean profitability and consistency with a UPR of 6. Nuvoco and Sagar Cement secure a UPR of 13.5, reflecting their higher consistency scores despite lower mean profitability. Meanwhile, India Cement faces challenges in both mean profitability and consistency, resulting in the highest combined rank of 15. Star Cement ranks fifth, with a UPR of 5, driven by its high mean profitability despite slightly lower consistency. Heidelberg and Dalmia both face challenges, earning UPRs of 9 and 11.5, respectively, due to lower consistency scores. JK Cement and JK Lakshmi Cement also face a similar trade-off between mean profitability and consistency, resulting in UPRs of 7.5 and 11.5, respectively. Finally, Orient Cement maintains a relatively balanced performance, securing a UPR of 10 (Tables 6, 7 and 8).

Profitability Analysis Using Efficiency Scores (PCA)

All these four variables such as sales, operating profit, direct expenses, and indirect expenses are responsible for profitability and these variables individually affect profitability but to consolidate their contribution into profitability we use principal component analysis (PCA) by which we can assign unequal different weights for these variables to the profitability analysis. After weighting the unequal weights of the variables, we use weighted mean to calculate a composite index for profitability analysis. This index ranges between 0 and 1 for 15 different companies for a period. The value of those who are closer to 1 is considered more profitable for that certain company under a particular period and whose value id far from 1 is considered as less profitable for that company under a particular period.

Table 9 Analysis of Profitability Index under PCA method of the Selected Companies.

The analysis of profitability index under the PCA method reveals insights into the performance of selected companies over multiple years. Ultratech exhibits a mean profitability index of 0.076 with minimal variability (S.D. = 0.004) but a highly skewed distribution (C.S. = 17.216), suggesting consistency with potential outliers. Grasim Industries follows closely with a mean index of 0.067, slightly higher variability (S.D. = 0.006), and a skewed distribution (C.S. = 11.838). Ambuja Cement demonstrates a higher mean index of 0.082 with moderate variability (S.D. = 0.009) and a skewed distribution (C.S. = 8.696). Shree Cement stands out with the highest mean index of 0.085, moderate variability (S.D. = 0.012), and a skewed distribution (C.S. = 7.063), indicating strong performance. Acc Cement and JK Cement show mean indices of 0.068, with Acc Cement exhibiting moderate variability (S.D. = 0.012) and a skewed distribution (C.S. = 5.499), while JK Cement displays relatively lower variability (S.D. = 0.010) and a skewed distribution (C.S. = 6.681).

Table 6 Computation of ultimate rank based on the mean value of the selected profitability measures of the selected companies

Company	Mean GPR	Rank	Mean NPR	Rank	Mean OPR	Rank	Mean ROCE	Rank	Mean RONW	Rank	Sum of ranks	Ultimate rank
Ultratech	49.36	7	10.01	5	14.65	3	12.72	6	11.90	5	26	4
Grasim Industries	41.95	11	8.91	6	14.20	4	10.44	10	11.94	4	35	6.5
Ambuja Cement	56.19	2	10.23	4	12.06	8	14.90	1	11.72	7	22	3
Shree Cement	54.51	3	13.00	1	14.03	5	14.85	2	15.05	1	12	1
Acc Cement	47.36	8	7.63	7	8.73	13	14.74	4	10.41	9	41	9
Dalmia	56.39	1	3.25	14	10.34	9	6.40	14	2.92	14	52	11
JK Cement	46.09	9	5.51	9	12.39	7	11.73	9	11.75	6	40	8
Ramco Cement	36.79	13	10.83	3	16.69	1	12.10	7	12.39	3	27	5
Nuvoco	40.69	12	4.02	13	8.62	14	7.12	13	4.99	13	65	14
JK Lakshmi Cement	34.23	14	4.33	12	8.85	12	10.11	11	9.37	11	60	12
India Cement	50.02	6	0.64	15	6.85	15	4.69	15	0.85	15	66	15
Star Cement	54.42	4	11.36	2	14.79	2	13.72	5	14.76	2	15	2
Heidelberg	44.34	10	6.47	8	12.80	6	14.82	3	11.10	8	35	6.5
Orient Cement	51.99	5	4.93	10	10.20	10	11.95	8	9.84	10	43	10
Sagar Cement	28.98	15	4.72	11	9.43	11	9.13	12	5.10	12	61	13

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

Table 7 Computation of ultimate rank based on the consistency of the selected profitability measures of the selected companies

Company	CS in GPR	Rank	CS in OPR	Rank	CS in NPR	Rank	CS in ROCE	Rank	CS in RONW	Rank	Sum of ranks	Ultimate rank
Ultratech	18.21	2	6.02	1	3.72	2	8.65	1	4.45	1	7	1
Grasim Industries	19.76	1	4.35	2	3.60	3	3.71	4	4.16	2	12	2
Ambuja Cement	10.15	6	3.46	3	3.81	1	4.13	2	3.73	3	15	3
Shree Cement	11.34	4	2.84	6.5	2.83	4	3.38	5	2.89	4	23.5	4
Acc Cement	5.82	7	2.62	9	2.64	5	4.07	3	2.78	5	29	5
Dalmia	4.71	9	1.80	12	0.75	14	2.53	9	0.75	13	57	11
JK Cement	11.06	5	3.35	4	1.91	8	3.11	6	2.09	8	31	6
Ramco Cement	2.88	14	2.98	5	2.28	6	2.85	8	2.56	6	39	8
Nuvoco	3.11	13	1.51	14	0.96	12	1.82	12	1.10	12	63	13
JK Lakshmi Cement	3.60	11	2.64	8	1.41	9	1.93	10.5	1.11	11	49.5	10
India Cement	4.55	10	1.22	15	0.23	15	1.40	15	0.38	15	70	15
Star Cement	5.39	8	2.84	6.5	1.97	7	3.04	7	2.22	7	35.5	7
Heidelberg	3.24	12	2.08	11	1.15	11	1.72	14	1.22	10	58	12
Orient Cement	13.13	3	2.29	10	1.22	10	1.93	10.5	1.28	9	42.5	9
Sagar Cement	2.84	15	1.56	13	0.95	13	1.76	13	0.73	14	68	14

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

Table 8 Computation of ultimate profitability rank considering both the mean and consistency parameters of the selected profitability measures of the selected companies

Company	Ultimate rank based on mean	Ultimate rank based on consistency score	Sum of ranks	Ultimate profitability rank (UPR)
Ultratech	4.00	1	5.00	1.5
Grasim Industries	6.50	2	8.50	4
Ambuja Cement	3.00	3	6.00	3
Shree Cement	1.00	4	5.00	1.5
Acc Cement	9.00	5	14.00	7.5
Dalmia	11.00	11	22.00	11.5
JK Cement	8.00	6	14.00	7.5
Ramco Cement	5.00	8	13.00	6
Nuvoco	14.00	13	27.00	13.5
JK Lakshmi Cement	12.00	10	22.00	11.5
India cement	15.00	15	30.00	15
Star Cement	2.00	7	9.00	5
Heidelberg	6.50	12	18.50	9
Orient Cement	10.00	9	19.00	10
Sagar Cement	13.00	14	27.00	13.5

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

Dalmia's mean index is 0.065 with slightly higher variability (S.D. = 0.014) and a skewed distribution (C.S. = 4.660). These insights reflect varying levels of profitability and stability among the companies, guiding further analysis and decision-making processes. Ramco Cement displays a mean profitability index of 0.066, with slight variability reflected in a standard deviation of 0.016 and a moderate skewness coefficient of 4.024. Nuvoco presents a mean index of 0.053, indicating a lower level of profitability compared to Ramco Cement, with a standard deviation of 0.019 and a relatively low skewness coefficient of 2.829. JK Lakshmi Cement exhibits a mean profitability index of 0.053, with a standard deviation of 0.006 and a higher skewness coefficient of 8.611, suggesting a more varied performance. India Cement demonstrates a mean index of 0.053, akin to JK Lakshmi Cement, with a slightly higher standard deviation of 0.007 and a skewness coefficient of 7.814. Star Cement shows a mean index of 0.084, with a standard deviation of 0.018 and a skewness coefficient of 4.720, indicating a relatively stable performance. Heidelberg presents a mean index of 0.068, with a standard deviation of 0.022 and a skewness coefficient of 3.162, reflecting moderate variability. Orient Cement displays a mean index of 0.067, with

Table 9 Analysis of profitability index under PCA method of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	0.075	0.082	0.072	0.081	0.072	0.067	0.077	0.076	0.075	0.081	0.076	0.004	17.216
Grasim Industries	0.074	0.074	0.060	0.060	0.065	0.061	0.074	0.072	0.063	0.070	0.067	0.006	11.838
Ambuja Cement	0.070	0.095	0.077	0.085	0.088	0.075	0.075	0.077	0.078	0.101	0.082	0.009	8.696
Shree Cement	0.065	0.086	0.084	0.085	0.081	0.089	0.091	0.108	0.067	0.096	0.085	0.012	7.063
Acc Cement	0.055	0.058	0.070	0.075	0.086	0.074	0.071	0.068	0.043	0.083	0.068	0.012	5.499
Dalmia	0.098	0.064	0.070	0.058	0.053	0.061	0.045	0.075	0.067	0.055	0.065	0.014	4.660
JK Cement	0.066	0.077	0.077	0.082	0.073	0.069	0.069	0.046	0.060	0.059	0.068	0.010	6.681
Ramco Cement	0.037	0.058	0.060	0.058	0.062	0.067	0.096	0.091	0.072	0.057	0.066	0.016	4.024
Nuvoco	0.041	0.045	0.047	0.041	0.028	0.054	0.057	0.045	0.070	0.099	0.053	0.019	2.829
JK Lakshmi Cement	0.050	0.055	0.054	0.054	0.049	0.045	0.051	0.039	0.060	0.060	0.052	0.006	8.611
India Cement	0.064	0.045	0.052	0.048	0.050	0.050	0.064	0.057	0.057	0.044	0.053	0.007	7.814
Star Cement	0.115	0.064	0.058	0.082	0.101	0.105	0.085	0.081	0.089	0.064	0.084	0.018	4.720
Heidelberg	0.099	0.069	0.076	0.092	0.094	0.067	0.056	0.048	0.055	0.027	0.068	0.022	3.162
Orient Cement	0.068	0.087	0.079	0.068	0.067	0.059	0.046	0.057	0.091	0.080	0.070	0.013	5.273

(continued)

Table 9 (continued)

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Sagar Cement	0.025	0.042	0.064	0.031	0.029	0.057	0.043	0.058	0.053	0.025	0.043	0.014	3.042
											0.067		6.742

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

a standard deviation of 0.013 and a moderate skewness coefficient of 5.273. Lastly, Sagar Cement exhibits a mean index of 0.041, with a standard deviation of 0.014 and a skewness coefficient of 3.042, indicating a less profitable performance compared to other companies.

Table 10 Computation of Ultimate Profitability Rank Considering Both the mean and Consistency of Profitability index of the Selected Companies.

In the computation of the ultimate profitability rank considering both the mean and consistency of the profitability index for the selected companies, Ultratech emerges as the top performer with a mean profitability of 0.076 and the lowest consistency rank of 1.00, securing the first position. Shree Cement follows closely, ranking second with a mean profitability of 0.085 and a consistency rank of 6.00. Grasim Industries and Ambuja Cement tie for the third position, both displaying competitive mean profitability but slightly varying consistency ranks. JK Cement secures the sixth position with a mean profitability of 0.068 and a consistency rank of 6.68, while Acc Cement follows closely with a similar mean profitability but a slightly higher consistency rank. Dalmia ranks seventh, reflecting a lower mean profitability compared to others. In the computation of the ultimate profitability rank considering both the mean and consistency of the profitability index for the selected companies, Nuvoco ranks fourteenth with a mean profitability of 0.053, reflecting lower mean profitability and consistency compared to others. JK Lakshmi Cement secures the tenth position with a mean profitability of 0.052 and a relatively higher consistency rank of 8.61, indicating a less competitive performance. India Cement follows closely, ranking ninth, with a similar mean profitability but a slightly lower consistency rank. Star Cement

Table 10 Computation of ultimate profitability rank considering both the mean and consistency of profitability index of the selected companies

Company	Mean	Rank	C.S.	Rank	Sum of ranks	Ultimate rank
Ultratech	0.076	4.00	17.22	1.00	5.00	1.00
Grasim Industries	0.067	9.00	11.84	2.00	11.00	3.50
Ambuja Cement	0.082	3.00	8.70	8.00	11.00	3.50
Shree Cement	0.085	1.00	7.06	6.00	7.00	2.00
Acc Cement	0.068	7.00	5.50	8.00	15.00	8.00
Dalmia	0.065	11.00	4.66	11.00	22.00	12.50
JK Cement	0.068	7.00	6.68	7.00	14.00	6.50
Ramco Cement	0.066	10.00	4.02	12.00	22.00	12.50
Nuvoco	0.053	12.50	2.83	15.00	27.50	14.00
JK Lakshmi Cement	0.052	14.00	8.61	4.00	18.00	10.00
India cement	0.053	12.50	7.81	5.00	17.50	9.00
Star Cement	0.084	2.00	4.72	10.00	12.00	5.00
Heidelberg	0.068	7.00	3.16	13.00	20.00	11.00
Orient Cement	0.070	5.00	5.27	9.00	14.00	6.50
Sagar Cement	0.043	15.00	3.04	14.00	29.00	15.00

secures the fifth position with a mean profitability of 0.084 and a consistency rank of 4.72, demonstrating a higher level of profitability and consistency compared to others. Heidelberg ranks eleventh with a mean profitability of 0.068 and a consistency rank of 3.16, showcasing moderate performance. Orient Cement secures the sixth position with a mean profitability of 0.070 and a consistency rank of 5.27, reflecting a relatively stable performance. Lastly, Sagar Cement closes the list, ranking fifteenth due to lower mean profitability and consistency compared to others. Overall, the ultimate profitability rank offers a comprehensive assessment, considering both mean profitability and consistency, to evaluate the companies' performance effectively.

Profitability Analysis Using Efficiency Scores (DEA)

An attempt was taken to ascertain the profitability situation of the selected enterprises applying the DEA technique more accurately. In the present investigation, the input elements were direct and indirect expenditures, while the output components were revenues and operating profit. The DEA model maximises the output components and minimises the input elements to differentiate the comparable outcomes of different companies. Each of the companies was treated as a homogeneous unit for the purposes of benchmarking, and their comparative performance was evaluated using the DEA methodology. Each of the 15 companies that were chosen received an efficiency score using the DEA methodology, which was calculated on a scale of 0–1.

Table 11 Analysis of profitability Score under DEA techniques of the Selected Companies.

The table presents an analysis of profitability scores under DEA (Data Envelopment Analysis) techniques for selected companies across various years. Ultratech consistently achieves a perfect score of 1 across all years, indicating high efficiency and profitability. The mean score of 1 signifies outstanding performance over the years with minimal variation (standard deviation of 0.001). Grasim Industries also maintains a perfect score of 1 for most years, except for 2016–17 where it slightly drops to 0.992. The company exhibits high consistency and mean profitability, with a small standard deviation (0.002). Ambuja Cement shows excellent performance with mostly perfect scores, except for 2020–21 with a slight dip to 0.979. Despite this, Ambuja Cement maintains high mean profitability and consistency, with a moderate standard deviation (0.007). While generally performing well, Shree Cement displays some variability in scores, particularly in 2015–16 and 2014–15. The mean profitability is high (0.980), but the standard deviation is relatively higher (0.040), indicating fluctuations in performance. Acc Cement demonstrates consistent performance with scores mostly above 0.9, indicating high efficiency. However, there is some variability in scores across years, leading to a slightly higher standard deviation (0.039). Dalmia shows mixed performance with some years scoring below 0.9, indicating potential areas for improvement. The standard deviation is relatively higher (0.066), suggesting fluctuations in profitability over time. JK Cement maintains relatively consistent performance with scores mostly above 0.9, but like Dalmia,

Table 11 Analysis of profitability score under DEA techniques of the selected companies

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Ultratech	1	1	1	1	1	1	1	1	0.99623	1	1.000	0.001	837.595
Grasim Industries	1	1	1	1	1	1	0.99216	1	1	1	0.999	0.002	402.830
Ambuja Cement	1	1	0.97902	1	1	1	1	1	1	1	0.998	0.007	150.395
Shree Cement	0.98225	1	1	1	0.99706	1	1	1	0.88231	0.9338	0.980	0.040	24.512
Acc Cement	0.95763	0.90488	0.96441	0.97817	0.98176	0.98552	0.92197	0.88987	1	0.91303	0.950	0.039	24.402
Dalmia	1	0.9056	0.9639	1	0.95584	0.95431	0.81861	1	0.87172	0.856	0.933	0.066	14.182
JK Cement	0.96989	0.92984	0.94423	0.95341	0.92465	0.90763	0.86182	0.89515	0.9035	0.85656	0.915	0.037	24.563
Ramco Cement	1	1	1	1	1	1	1	1	0.99211	0.86903	0.986	0.041	23.927
Nuvoco	0.96554	0.84826	0.87267	1	1	0.8919	0.88131	1	0.93014	1	0.939	0.061	15.311
JK Lakshmi Cement	1	0.922	1	0.93098	0.90077	0.84855	0.86926	0.85424	0.91874	0.93139	0.918	0.053	17.282
India Cement	0.95421	0.87693	0.9078	0.87635	0.8883	0.89013	0.87629	0.86783	0.85518	0.76892	0.876	0.046	18.850
Star Cement	1	1	0.96131	1	1	1	1	0.99996	1	1	0.996	0.012	81.419
Heidelberg	1	0.96144	0.88531	1	0.91076	0.81638	0.95579	0.89625	0.89666	1	0.932	0.061	15.206

(continued)

Table 11 (continued)

Company	Year										Mean	S.D.	C.S.
	2022–23	2021–22	2020–21	2019–20	2018–19	2017–18	2016–17	2015–16	2014–15	2013–14			
Orient Cement	0.96983	1	1	1	1	0.89246	0.8837	0.93541	1	0.99469	0.968	0.047	20.678
Sagar Cement	1	1	1	0.99562	1	1	1	1	1	1	1.000	0.001	721.830

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

it displays variability in scores. The standard deviation is moderate (0.037). Ramco Cement achieves high scores except for 2013–14, indicating strong overall performance. However, it exhibits a slightly higher standard deviation (0.041), implying fluctuations in profitability. Nuvoco shows a mix of scores with some years below 0.9, suggesting potential areas for improvement. The standard deviation is relatively higher (0.061), indicating variability in performance. JK Lakshmi Cement displays relatively consistent performance, but with some variability in scores across years. The standard deviation is moderate (0.053). India Cement shows consistent performance with scores mostly above 0.8, but with variability across years. The standard deviation is moderate (0.046). Star Cement maintains high scores with slight variability, particularly in 2020–21. The standard deviation is minimal (0.012), indicating consistent performance. Heidelberg shows variability in scores with some years below 0.9. The standard deviation is relatively higher (0.061). Orient Cement demonstrates mostly consistent performance with scores above 0.9, but with variability. The standard deviation is moderate (0.047). Sagar Cement achieves a perfect score of 1 across all years, indicating high efficiency and profitability consistently. The mean score of 1 signifies outstanding performance over the years with minimal variation (standard deviation of 0.001). Overall, most companies demonstrate strong performance with high mean profitability scores and relatively low standard deviations, indicating consistency in profitability over time. However, some companies exhibit variability in scores, suggesting areas for improvement in efficiency and profitability.

Table 12 Computation of Ultimate Profitability Rank under DEA techniques considering both the mean and Consistency of Profitability score of the Selected Companies.

The table presents the computation of the ultimate profitability rank under DEA (Data Envelopment Analysis) techniques, considering both the mean and consistency of profitability scores for selected companies. Ultratech secures the top position with a perfect mean score of 1.000, achieving a combined rank of 1.50. It also maintains a high consistency score (C.S.) of 867.60, resulting in an ultimate rank of 1.00. Grasim Industries follows closely with a mean score of 0.999 and a combined rank of 3.00. Despite a slightly lower consistency score of 402.83, Grasim maintains a strong overall rank of 3.00. Ambuja Cement ranks third with a mean score of 0.998 and a combined rank of 4.00. While its consistency score is lower at 150.39, it still secures a solid ultimate rank of 4.00. Shree Cement secures the sixth position with a mean score of 0.980 and a combined rank of 7.00. Its lower consistency score of 24.51 contributes to its overall rank of 6.00. Acc Cement ranks ninth with a mean score of 0.950 and a combined rank of 9.00. Although it maintains a similar consistency score as Shree Cement, its mean score contributes to its slightly lower overall rank of 8.00. Dalmia secures the eleventh position with a mean score of 0.933 and a combined rank of 11.00. Its consistency score of 14.18 places it towards the lower end of the rankings, resulting in an overall rank of 14.00. JK Cement ranks fourteenth with a mean score of 0.915 and a combined rank of 14.00. Despite its relatively high consistency score of 24.56, its lower mean score contributes to its overall rank of 10.00. Ramco Cement secures the seventh position with a mean score of 0.986 and a

Table 12 Computation of ultimate profitability rank under DEA techniques considering both the mean and consistency of profitability score of the selected companies

Company	Mean	Rank	C.S.	Rank	Sum of ranks	Ultimate rank
Ultratech	1.000	1.50	867.60	1.00	2.50	1.00
Grasim Industries	0.999	3.00	402.83	3.00	6.00	3.00
Ambuja Cement	0.998	4.00	150.39	4.00	8.00	4.00
Shree Cement	0.980	7.00	24.51	7.00	14.00	6.00
Acc Cement	0.950	9.00	24.40	8.00	17.00	8.00
Dalmia	0.933	11.00	14.18	15.00	26.00	14.00
JK Cement	0.915	14.00	24.56	6.00	20.00	10.00
Ramco Cement	0.986	6.00	23.93	9.00	15.00	7.00
Nuvoco	0.939	10.00	15.31	13.00	23.00	11.00
JK Lakshmi Cement	0.918	13.00	17.28	12.00	25.00	12.00
India Cement	0.876	15.00	18.85	11.00	26.00	14.00
Star Cement	0.996	5.00	81.42	5.00	10.00	5.00
Heidelberg	0.932	12.00	15.21	14.00	26.00	14.00
Orient Cement	0.968	8.00	20.68	10.00	18.00	9.00
Sagar Cement	1.000	1.50	721.83	2.00	3.50	2.00

Source Compiled and computed from Capitaline Corporate Database, Capital Market Publishers (India) Ltd., Mumbai

combined rank of 6.00. Its consistency score of 23.93 contributes to its overall rank of 7.00. Nuvoco ranks tenth with a mean score of 0.939 and a combined rank of 10.00. Its consistency score of 15.31 places it towards the middle of the rankings, resulting in an overall rank of 11.00. JK Lakshmi Cement ranks thirteenth with a mean score of 0.918 and a combined rank of 13.00. Its consistency score of 17.28 contributes to its overall rank of 12.00. India Cement ranks fifteenth with a mean score of 0.876 and a combined rank of 15.00. Its consistency score of 18.85 places it towards the lower end of the rankings, resulting in an overall rank of 14.00. Star Cement secures the fifth position with a mean score of 0.996 and a combined rank of 5.00. Its relatively high consistency score of 81.42 contributes to its strong overall rank of 5.00. Heidelberg ranks twelfth with a mean score of 0.932 and a combined rank of 12.00. Its consistency score of 15.21 places it towards the middle of the rankings, resulting in an overall rank of 14.00. Orient Cement secures the eighth position with a mean score of 0.968 and a combined rank of 8.00. Its consistency score of 20.68 contributes to its overall rank of 9.00. Sagar Cement shares the top position with Ultratech, with a perfect mean score of 1.000 and a combined rank of 1.50. Its consistency score of 721.83 results in an overall rank of 2.00. Overall, the rankings reflect a combination of mean profitability and consistency scores, with companies

like Ultratech, Grasim Industries, and Ambuja Cement leading the pack due to their high mean scores and consistency in performance. Conversely, companies with lower mean scores or consistency scores rank lower in the list, highlighting potential areas for improvement in efficiency and profitability.

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Sri Lankan Economic Crisis and Comparative Positions of Two of Its Neighbouring Countries

Soumodeep Das, Jaydip Sen, and Sayantani Roy Choudhury

Introduction

A recession implies to a significant drop-in economic activity that remains for a long period, typically characterized by a decrease in GDP, employment rates, consumer spending, and business investment. Recessions are usually identified by negative GDP growth for two or more consecutive quarters (In a particular financial year) which leads towards reduced consumer confidence, increased unemployment, and financial instability. In contrast, a depression is an all about an extended and severe form of economic downturn, identified over a long period of economic contraction, rising unemployment, and a significant decline in the industrial production and investment. Depressions are considered as rare and are more critical than recessions, usually last for a few years and result in significant social and economic turmoil. Both recessions and depressions have significant impacts on individuals, businesses, and governments, at micro and macro level which requires policy interventions to stimulate economic recovery and mitigate adverse effects on society. The Great Depression identified as one of the most intimidating economic challenges the world has ever encountered. This economic turmoil leaves a permanent mark on global economic history. As scholars investigate into the depths of economic downturns, an overflow of research has emerged which focuses to unravel the intricate factors that trigger such crises or downturns. Theoretical constructs, empirical investigations, and comprehensive time-series analyses have been significant in identifying the underlying causes of these recessions, providing important insights into

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the complexities of economic instability. Recessions and depressions are complex phenomena influenced by a mix of interconnected factors. Some common factors behind these economic downturns include fluctuations in consumer and business confidence, which can lead to decreased spending and investment over a market. Moreover, changes in worldwide economic circumstances, such as shifts in trade dynamics or fluctuations in commodity prices, can have consequences on a nation's economic position. Furthermore, decisions made by the central banks regarding monetary policies, such as adjustments in interest rates, are highly important for giving shape to economic activity. Fiscal policies, including government spending and taxation, can either stimulate or dampen economic growth depending on their implementation. Financial market instability, such as banking crises or asset price bubbles, can further intensify economic downturns by disrupting credit flows and investment. Moreover, external shock like natural disasters or geopolitical events, can easily trigger or deepen recessions and depressions. Understanding the complex interplay of these factors is extremely essential for policymakers and economists in managing and mitigating the effects of economic downturns.

Among the records of economic crises, the Southeast Asian crisis of 1997 **looms** large, casting a shadow of concern across East and Southeast Asia. This crisis, which swept through the region, triggered intense scholarly inquiry, with researchers undertook to dissect its cause and outcomes. Notable contributions, such as the study on financial communication during the Asian financial crisis by Kalkavan and Ersin (2019), has highlighted an important role of communication between authorities and markets during times of crisis. By examining economic data from South Korea, Malaysia, the Philippines, and Thailand, spanning from 1975 to 2006, the study highlights the significance of economic indicators such as CPI inflation, GDP growth, unemployment, financial credits, and money supply in influencing the path of crises.

In the era where data become an important component to economic forecasting, the predictive capacity of the yield curve has comes out as a main point of understanding the performance of an economy. Notably, studies such as those conducted by Khomo and Aziakpono (2007) and Filardo (1999) have scrutinised the effectiveness of the yield curve in identifying recessions or indicate recessions. Khomo and Aziakpono highlighted the greater power of the yield curve compared to other variables in long-term prediction, while Filardo's composite index of leading indicators underscored the importance of corroboration of various models to enhance predictive capacity.

Furthermore, the efficiency of recession prediction models has gained high attention in economic research to understand the cause and to predict early. Scholars like Wright (2006) have explored the usage of probit models in forecasting recessions, highlighting the role of important variables such as yield curve spread and stock prices in macroeconomic prediction. Similarly, Proaño (2010) adopted a comprehensive analysis of financial and real economic variables, applying a multivariate approach to enhance predictive accuracy and input more significant information.

The economic landscape of Australia during the early 1990s focused by researchers as a fertile ground for examining the complexity of recessionary dynamics. Weber's (1994) investigation into the role of money during Australia's recession highlights the interplay between domestic and foreign factors in mitigating

economic downturns. Moreover, studies by Estrella and Mishkin (1998) bring attention on the predictive capabilities of variables such as stock prices and the slope of the yield curve, offering valuable and quantitative insights into recession prediction methodologies.

Amidst the tumult of economic crises, the Great Recession identified as a serious moment, helps scholars such as Ng and Wright (2013) to Study and examine its multifaceted dimensions. Through precise analyses of time series properties and volatility dynamics, scholars' effort to identify the underlying mechanism or factors driving economic fluctuations, with a keen focus on financial frictions, leverage, and uncertainty has been studied. In the era of the diverse array of research efforts which is aimed at identifying the root cause of economic recessions, this literature review embarks on a comprehensive journey through the annals of economic scholarship. By synthesizing key insights from pioneering studies, this review put an effort to elucidate the intricacies of recessionary dynamics, offering a nuanced understanding of the factors shaping the ebb and flow of economic fortunes.

Sri Lanka is going through an economic crisis which started three years ago. This crisis created great hardship for the citizens of the island nation. Frequent power outages, food shortages, high, no medicine and no fuel were the consequences. Several economic factors are describing the harsh situation of the island paradise as high external debt, less foreign currency reserve, increasing poverty, etc. According to a report at least 500,000 Sri Lankan fell into poverty due to significant inflation and unemployment issues. CCPI (Colombo Consumer Price Index) based headline inflation is recorded as 54.6% in the year 2022. A study has shown that the Sri Lankan corporate sector does not have efficient regulations. As Sri Lanka has smooth growth in population it requires employment as well. According to United Nations experts, Sri Lanka's economic downturn needs instant global care. The problem has become a humanitarian problem and not only humanitarian agencies but private institutions and countries have to come together forward in such situation. In this paper a study is being done to find out the indicators which lie beside Sri Lanka's economic crisis with the help of Statistical analysis. Two countries (India and Bangladesh) are studied along with Sri Lanka to come up with conclusions.

Literature Review

The socio-political system of Sri Lanka inbreds an extremely modest pluralistic system. This system is very much prevalent in the third world countries (Wilson, 1979). The democracy of the country allows people of the country to cast their vote in the general election, where they can elect their representative. So, in the political participation, people hold the decision-making power. The economy has failed to generate adequate resources and opportunities demanded by the society. The inadequate economic opportunity has created an impediment to the progress of the nation. The economic liberalization in Sri Lanka had started in 1977 in direction towards socialism. The extensive economic liberalization policy forced them a paradigm shift

from the agriculture to the services and manufacturing sectors. The economy slowly progressed towards the industrialized economy with the development of textile, telecommunication, food processing (Nubin, 2002). Growth of the economy was modest at that time with significant fluctuations. The fluctuation of GDP was observed due to the micro and macroeconomic environment of the economy. Overall, growth of the economy had gone through a structural transformation and the major shift of the sectoral contribution had been observed.

Economic recessions are complex phenomena with multifaceted causes that have been studied extensively in the context of various countries and historical periods. Drawing insights from past recessions in different countries provides valuable lessons for understanding the factors contributing to economic downturns. This literature review examines key empirical studies and theoretical frameworks to elucidate the causes of economic recessions using examples from different countries.

Great depression is one of the major economic downturns which is faced by the world. Researchers have performed extensive studies to investigate the key reasons behind great depression. Theoretical, empirical and time series study has been done to understand the key factors or reasons behind this recession. The Great Depression serves as a prominent example of a recession driven by a combination of demand-side and financial factors. The share market smash of 1929 caused a sharp decline in consumer spending and investment, leading to a contraction in aggregate demand (Bernanke, 1983). Additionally, widespread bank failures and a lack of effective monetary policy exacerbated the crisis, contributing to deflationary pressures and prolonged unemployment (Friedman & Schwartz, 1963).

The Southeast Asian crisis is one of the crises which spreads fears to the whole world. This crisis gripped east and most of southeast Asia countries in 1997. The study of fiscal statement in the Asian financial crisis (Kalkavan & Ersin, 2019) helped to read the crisis better. Economic data of South Korea, Malaysia, Philippines and Thailand has been taken within the time period of 1975 to 2006 from the World Bank database. The study used a logit model by taking Inflation, GDP Growth, Unemployment, Finance Surplus, Public Debt, Current account balance, Money Supply, Saving, Interest rate as dependent variables. They have taken financial crisis as dependent variable. Crisis became a significant function of growth of the economy, financial credit and money supply.

Research in economics often evaluates the predictive capacity of the yield curve against other economic indicators. A study on recession prediction in South Africa examines changes in stock prices, money supply growth, and the index of leading economic indicators alongside the yield curve theory. Utilizing the Probit model, it correlates the probability of a recession in South Africa, as dated by the SARB, with the slope of the yield curve observed several months earlier. This study compares the standard Probit model proposed by Estrella and Mishkin (1996) with the modified version suggested by Dueker (1997), assessing the yield curve's predictive power against variables like real money supply growth, stock price changes, and leading economic indicators. Khomo and Aziakpono (2007) assert that compared to other variables, the yield curve performs better for long-term predictions, underscoring the importance of the recession prediction model's effectiveness.

Filardo (1999) creates a composite leading indicator index using NBER data, with the Treasury yield spread as a dependent variable. Various models, including simple CLI rules, the Neftçi model, Probit model, GDP forecasting model, and Stock-Watson model, are analyzed. The study finds that clear recession signals emerge when all models concur, highlighting the yield curve's superiority over time horizons beyond one quarter.

Examining the Australian economic crisis of 1990–1992, Weber (1994) investigates the role of money during the recession. Using variables like the Australian GDP implicit price deflator, money stock MI, US real GDP, and the British three-month Treasury bill rate, the study employs vector autoregression (VAR) to analyze historical decomposition. Weber concludes that foreign mitigating factors alleviated the severity of the recession. Notably, recession prediction holds greater significance than growth forecasting in economic research. Wright (2006) establishes the usefulness of the yield curve spread and stock prices in macroeconomic prediction through various probit models, underscoring their significant roles.

Proaño (2010) utilized data from the Bundesbank database, excluding orders from the Genesis-Online database of the German Federal Statistical Office and the business cycle climate index. The estimation period ranged from 1991 to 2010. It included diverse financial and real economic variables. These variables comprised real GDP, income, employment, industrial production, wholesale-retail sales, open vacancies in the productive sector, domestic and foreign orders received by the industrial sector, spread between average corporate bond yields of all maturities and the average yield of public securities, and the growth rate of the CDAX price index. These variables were considered as independent variables to capture developments in the German stock markets. The model exhibited satisfactory performance beyond the sample period. Examining recessions and identifying associated challenges is a complex task. Ng and Wright (2013) focused on studying the Great Recession. They analyzed changing time series properties through factor analysis, providing new insights into these changes and emphasizing volatility dynamics. The study delved into the specific roles of financial frictions, leverage, and uncertainty in recent economic fluctuations, particularly during the Great Recession. Finally, they evaluated the effectiveness of econometric methodologies in studying the experiences from previous recessions.

Japan's experience during the 1990s which is known as the Lost Decade, offers valuable insights into the role of property value bubbles and financial inequalities in causing economic recessions. The collapse of the asset price bubble in the late 1980s led to a significant banking disaster and a long period of economic inactivity or turmoil (Koo & Kiser, 2001). Although there is aggressive monetary and fiscal triggered measures, Japan struggled to overcome deflationary pressures and revive growth. This event highlight the challenges of addressing financial sector weaknesses and structural rigidities (Ahearne et al., 2002).

The Global Financial Crisis was sparked by the collapse of the marginal mortgage market in the United States, offers valuable insights into how financial markets are interconnected and how economic shocks can spread across countries and contribute to significant economic turmoil. The growth of complex financial products, lax regulatory oversight, and excessive risk-taking by financial institutions triggered the

crisis fast, leading to a systemic meltdown (Reinhart & Rogoff, 2009). The significant effects spread rapidly to other countries, intensifying recessions and prompting coordinated policy responses at the global level (Obstfeld & Rogoff, 2009). The Eurozone Sovereign Debt Crisis offers lessons on the interplay between fiscal imbalances, structural weaknesses, and monetary policy constraints in triggering economic recessions. Excessive government debt levels, coupled with divergent competitiveness and institutional deficiencies within the Eurozone, triggered concerns about sovereign solvency and financial stability (Alesina & Ardagna, 2010). The rigid measures implemented to address fiscal imbalances can further intensify economic downturns. This downturn highlights the challenges of balancing fiscal consolidation with growth objectives (Blanchard & Leigh, 2013).

The COVID-19 pandemic recession makes people think on the role of external shocks and policy responses which has shaped the economic downturns. The unpredictable global health crisis which has led to widespread lockdowns, supply chain disruptions, and a collapse in demand has triggered a sharp contraction in economic activity (McKibbin & Fernando, 2020). Governments and central banks implemented extensive fiscal and monetary measures to support incomes, stabilize financial markets, and facilitated economic recovery by reducing the importance of timely and coordinated policy interventions in mitigating the impact of crises (Baldwin et al., 2020). Examining past recessions in different countries over different continents provides valuable insights into the diverse factors contributing to economic downturn which includes demand-side weaknesses, financial vulnerabilities, structural imbalances, and external shocks. By drawing lessons from historical experiences, policymakers can better anticipate, mitigate, and respond to future economic crises, promoting resilience and sustainable growth over economies.

The Sri Lankan economy has faced numerous challenges throughout its history unlike civil conflict to natural disasters. However, the recent economic crisis has gained significant attention both domestically and internationally with the massive disruption of supply and services. This literature review aims to give readers an inclusive overview of the variables which has contributed to the Sri Lankan economic crisis with its implications, and potential policy recommendations. The Sri Lankan economy has been suffering with several macroeconomic challenges which includes high public debt, fiscal deficits, and balance of payment issues. According to Jayatissa and Kumari (2020), the unsustainable management of public debt has been a major concern which led the country to debt distress and limited fiscal space for essential public investments which are considered as fuel to any economy. Furthermore, fiscal deficits for a long term have put pressure on government finance results leading to increased borrowing and dependency on external sources of financing (Gunasekara & Wijewardena, 2019). The external sector mismanagement has intensified the economic crisis in Sri Lanka. The widening trade deficit and declining foreign exchange reserves which are crucial to maintain imports have heightened concerns about the country's capability to meet its outside obligations or debts. De Silva and Ratnasiri (2019) argue that the overvalued exchange rate, combined with subdued export growth and rising imports, has contributed to the decline of the external balance. Political instability and policy uncertainty have significantly

worsened the economic crisis and leave a notable impact over the economy. The frequent changes in government and policy reversals have undermined investor confidence and hindered long-term planning and investment. According to Perera (2020), the lack of a coherent economic strategy and inconsistent policy measures have further weakened the economy's adaptability to external shocks. Structural bottlenecks which include poor infrastructure, low productivity, and rigid labour markets, have constrained the country's economic growth and restricted efforts to address the crisis effectively and efficiently. Fernando and Fernando (2018) highlight the necessity for structural modifications to improve competitiveness, enhance productivity, and attract foreign investment. The economic crisis in Sri Lanka has had profound social implications, exacerbating poverty, inequality, and unemployment. According to World Bank (2021), the COVID pandemic has further aggravated these challenges, disproportionately affecting vulnerable groups such as women, youth, and informal sector workers.

Methodology

World is concerned about the Sri Lankan economic crisis of 2022, which will be visible worldwide in 2020. The graph shows a similar downturn in GDP growth rate in two other neighbouring countries like Sri Lanka. So, what special thing has happened in Sri Lanka? In this paper we will go through several methods to examine the root cause of economic downtown on the island nation (Fig. 1).

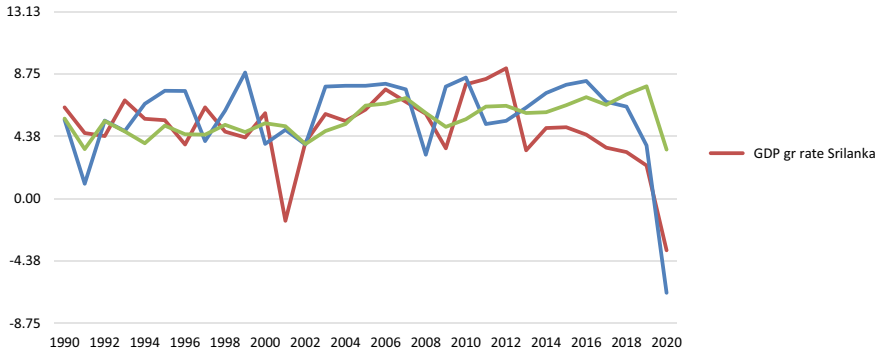

Fig. 1 GDP growth rate of Sri Lanka, India and Bangladesh

Analysis I

A model has been created with most important Macroeconomic factors. Ten years of data of those three countries have been collected from the World Bank and regression analysis has been done.

GDP growth rate = f (CPI inflation (annual average), Total central government debt (% of GDP), Credit to private sector by the banking system (% of GDP), Broad money (% of GDP), current account balance, FDI (% GDP), External debt (% GDP), Log Reserves (US $ millions)).

Since the objective is to find out short term factors behind the economic crisis in Sri Lanka, last 10 years' data has been collected. As the sample size is small, bivariate regressions have been done taking one variable at a time.

Regression Result

For Sri Lanka, Current account balance, Broad money (% of GDP) were statistically significant and inversely related to the GDP growth rate. For India, Broad money (% of GDP), Credit to private sector by the banking system and Total central government debt (percent of GDP) were influencing the GDP growth rate inversely. None of the variables are influencing Bangladesh GDP growth rate significantly. That means the reasons behind the GDP growth rate fluctuations is a function of different variables in these three different countries. Only broad money is common in India and Sri Lanka. Surprisingly, none of these macroeconomic factors are behind the changes of Bangladesh's GDP growth rate (Table 1).

Analysis 2

A model has been created with panel data.

GDP growth rate = f (Year, CPI inflation (annual average), Total central government debt (% of GDP), Broad money (% of GDP), current account balance, FDI (% GDP), Log Reserves (US $ millions)).

Panel data analysis with fixed effects is a statistical method used to analyze data that contains observations on multiple entities (such as individuals, firms, countries) over multiple time periods. Panel data, also known as longitudinal or cross-sectional time-series data, provides information on both individual entities and how they change over time.

Fixed effects refer to individual-specific effects that are assumed to be constant over time but can vary across entities. These effects capture unobserved heterogeneity among entities that do not change over time. For example, in a study of wage determinants among workers, fixed effects could capture unobserved characteristics such

Table 1 Output of analysis 1

Country	CPI inflation (annual average)	Total central government debt (% of GDP)	Credit to private sector by the banking system (% of GDP)	Broad money (% of GDP)	Current account balance	FDI (% GDP)	External debt (% GDP)	Reserves (US $ millions) LOG
Sri Lanka	0.2825	−0.3184	−0.3085	−0.3119*	−1.5235*	4.8947	−0.3808	25.3945
India	−0.1507	−1.0017*	−1.7962*	−0.9802*	−1.2873	−7.9397	0.9588	0.9588
Bangladesh	−0.0890	−0.3938	0.2092	−0.0882	−0.4042	0.2588	−0.0004	−0.2275

Asterisk values denote the level of significance

as innate ability or personality traits that vary across individuals but remain constant over the observation period.

In panel data analysis with fixed effects, these fixed effects are included in the model to account for individual-specific factors that do not change over time. This helps to control for omitted variable bias and allows researchers to estimate the effects of time-varying variables of interest more accurately.

The fixed effects model is typically estimated using techniques such as the within-group estimator (also known as the fixed effects estimator) or the first-difference estimator. These techniques involve subtracting individual-specific means or changes from the data before estimating the model. The resulting estimates capture the relationship between the variables of interest after controlling for individual-specific effects.

Output

In the present study the fixed effect model has been used with ninety-three observations. The model includes three cross sectional units. Time-series length is equal to thirty-one. GDP growth is considered as a dependent variable.

	Coefficient	Std. error	t-ratio	p-value	
Constant	301.955	136.452	2.213	0.0312	**
Year	−0.148000	0.0686374	−2.156	0.0355	**
Inflation	0.0305178	0.0696936	0.4379	0.6632	
Domestic credit	−0.133540	0.0633274	−2.109	0.0396	**
Broad money	−0.000333228	0.0579524	−0.005750	0.9954	
Current balance	−0.275836	0.157572	−1.751	0.0857	*
FDI	−0.201096	0.549285	−0.3661	0.7157	
Reserves	0.0207183	0.0119006	1.741	0.0874	*
dt_2	−3.30026	1.40617	−2.347	0.0226	**
dt_3	−0.842415	1.40779	−0.5984	0.5521	
dt_4	−0.116073	1.43527	−0.08087	0.9358	
dt_5	−0.388804	1.39640	−0.2784	0.7817	
dt_6	1.14845	1.31335	0.8744	0.3858	
dt_7	0.573644	1.29612	0.4426	0.6598	
dt_8	1.06706	1.40054	0.7619	0.4494	
dt_9	1.45090	1.28411	1.130	0.2635	
dt_10	2.29857	1.30090	1.767	0.0829	*
dt_11	1.48738	1.34399	1.107	0.2733	
dt_12	−0.0325883	1.26025	−0.02586	0.9795	
dt_13	1.65363	1.27150	1.301	0.1989	

(continued)

(continued)

	Coefficient	Std. error	t-ratio	p-value	
dt_14	3.87961	1.27827	3.035	0.0037	***
dt_15	3.83571	1.23415	3.108	0.0030	***
dt_16	4.80342	1.22496	3.921	0.0003	***
dt_17	5.86670	1.26682	4.631	<0.0001	***
dt_18	5.61595	1.28144	4.383	<0.0001	***
dt_19	3.27281	1.49325	2.192	0.0327	**
dt_20	4.73205	1.28564	3.681	0.0005	***
dt_21	6.54601	1.24687	5.250	<0.0001	***
dt_22	6.14402	1.34725	4.560	<0.0001	***
dt_23	6.88981	1.32880	5.185	<0.0001	***
dt_24	5.60608	1.30477	4.297	<0.0001	***
dt_25	6.84183	1.31221	5.214	<0.0001	***
dt_26	7.74233	1.32864	5.827	< 0.0001	***
dt_27	7.62827	1.33930	5.696	<0.0001	***
dt_28	6.67448	1.37682	4.848	<0.0001	***
dt_29	7.06516	1.46780	4.813	<0.0001	***
dt_30	6.39698	1.40300	4.559	<0.0001	***

LSDV R-squared	0.698674	Within R-squared	0.690291
Log-likelihood	−156.0715	Akaike criterion	390.1430

The study result of the joint test on named regressors shows that the test statistic: F value (7, 54) = 7.54657 with p-value = P (F(7, 54) > 7.54657) = 2.51418e-06. On the other side, the study result for differing group intercepts shows as follows:

Null hypothesis: The groups have a common intercept
Test statistic: F(2, 54) = 1.2102 with p-value = P(F(2, 54) > 1.2102) = 0.306093.

The Wald joint test on time dummies considers the null hypothesis as 'there is no time effects'. The asymptotic test statistic shows that the value of the Chi-square (29) = 91.5293 with p-value = 2.11342e-08.

Panel data analysis shows GDP growth rate is influenced by time with three other macroeconomic factors, Credit to the private sector by the banking system (% of GDP), current account balance and Reserves (US $ millions). Moreover, change in GDP is a function of earlier GDP fluctuations. But these are important factors for all three nations. That means from 2010 to 2020, the GDP growth rate was a function of the above-mentioned factors. But what happened to Sri Lanka that it could not recover after 2020 like the other two nations? Whether this kind of economic crisis is possible for India as well?

Analysis 3

Earlier analysis could not identify any significant difference between the reasons for the fall in GDP growth rate in these three nations. The downturn in their GDP growth rate has been exaggerated by the recent pandemic in 2020. The above analysis could not identify any special factor for which Sri Lanka would not recover from the downturn of GDP in 2020, but on the other hand they went inside a deep economic crisis.

Now, we have gone to search for this special factor in the yield curve! Yield curve is one popular indicator of recession. Since the macroeconomic factors could not give some very significant reasons, the yield curve could also be investigated. The following yield curve shows a matter of concern. It is flat and the second portion is inverted as well. We have taken the yield curve of the three countries, for the period of January 2019 to December 2021 (Figs. 2, 3 and 4).

There was a very long stretch of flat and inverted yield curve for Sri Lanka, whereas, for the other two countries the duration of flat or inverted yield curve is shorter. For India, it has started from the end of 2019, just before Covid. For Bangladesh it has happened from mid of 2020 which was basically due to Covid. Sri Lanka was experiencing it from mid of 2017.

Fig. 2 10 years bond yield, Jan 2019–Dec 2021, Sri Lanka

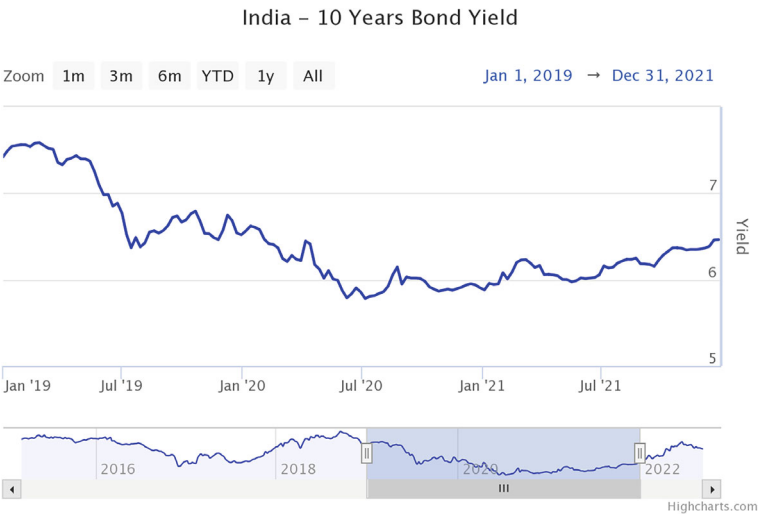

Fig. 3 10 years bond yield, Jan 2019–Dec 2021, India

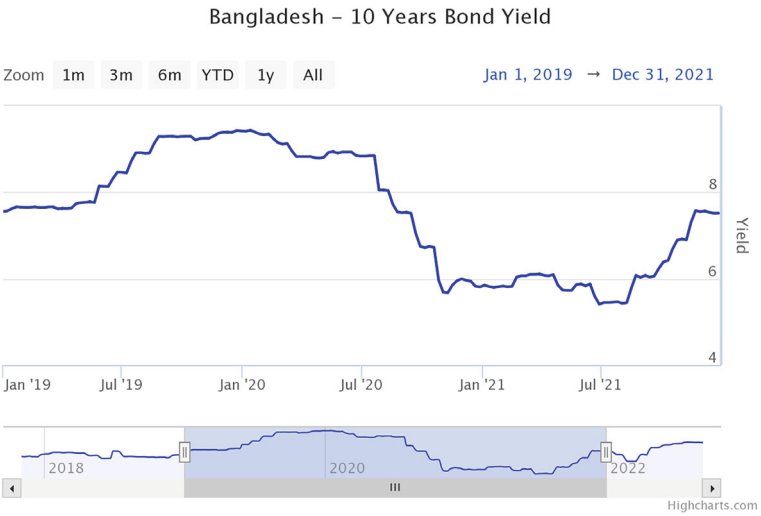

Fig. 4 10 years bond yield, Jan 2019–Dec 2021, Bangladesh

Conclusion

The bivariate regression analysis conducted on the macroeconomic factors influencing GDP growth rates in Sri Lanka, India, and Bangladesh over the past decade reveals distinct patterns and nuances in each country's economic dynamics. Sri Lanka's GDP growth rate appears to be significantly influenced by its current account

balance and the proportion of broad money relative to GDP. A deterioration in the current account balance and an increase in broad money as a percentage of GDP are associated with lower GDP growth rates, highlighting the importance of maintaining a healthy balance of payments and monitoring monetary expansion.

In India, a similar relationship is observed, with broad money, credit to the private sector by banks, and the level of government debt relative to GDP all exerting inverse influences on GDP growth rate. This suggests that India's economic performance is sensitive to monetary policy dynamics, private sector credit conditions, and fiscal management. Surprisingly, none of the macroeconomic factors examined significantly impact Bangladesh's GDP growth rate, indicating that other, possibly unexplored variables may play a more substantial role in driving economic fluctuations in the country. Further research into Bangladesh's economic context is warranted to better understand the unique determinants of its GDP growth rate. Overall, that analysis underscores the importance of tailored economic policy responses that consider country-specific dynamics. While some factors may be common across nations, the specific combination of variables influencing GDP growth rates varies, highlighting the complexity of economic systems and the need for nuanced policy approaches to promote sustainable economic growth.

The panel data analysis indicates that GDP growth rates in Sri Lanka, India, and Bangladesh from 2010 to 2020 were influenced by a combination of macroeconomic factors such as credit to the private sector by the banking system, current account balance, reserves, and past GDP fluctuations. However, despite the commonality of these factors across the three nations, Sri Lanka's inability to recover after 2020 raises concerns about the unique challenges it faces.

One notable difference is that Sri Lanka has experienced longer period of flat and inverted yield curves compared to India and Bangladesh. Sri Lanka's yield curve began flattening or inverting in mid-2017, much faster than the other two countries. This long yield curve may indicate hidden problems in the Sri Lankan economy. This is likely to answer the questions those were raised about whether India could face a similar economic crisis. Meanwhile, India's yield curve began flattening in late 2019, before the start of the COVID-19 pandemic. The duration of this shape change is short compared to Sri Lanka's. Whether India will face challenges similar to Sri Lanka during the post-pandemic recovery period is yet to be seen. The yield curve shape modification in Bangladesh is relatively small. This was largely driven by the impact of the COVID-19 pandemic. Since mid-2020, however, Bangladesh's economy may show resilience due to recent economic challenges compared to Sri Lanka. Overall, the different experiences of Sri Lanka, India and Bangladesh highlight the importance of considering economic dynamism and response to country-specific policies. Although general macroeconomic factors can affect GDP growth rates, the duration and severity of economic crises can vary significantly. This requires tailored strategies to address each country's unique challenges and to promote sustainable economic recovery. Combining the findings of the three analyses, a comprehensive understanding of the economic dynamics in Bangladesh, Sri Lanka and India can be gained. According to evidence, the slowdown in GDP growth in Bangladesh is mainly due to the COVID-19 pandemic. In Bangladesh, the downturn in GDP

growth primarily starts from the COVID-19 pandemic, which we can understand from the insignificance of macroeconomic factors. That is because their recession period was limited to 2020–2021. Conversely, Sri Lanka's GDP growth is notably affected by its negative current account balance which was a unique factor specific to the country, along with a decrease in the proportion of broad money relative to GDP. The prolonged recession in Sri Lanka, reflected in its unique yield curve, indicates a cumulative impact of various factors, notably including a high inflation rate. In India, a decrease in the proportion of broad money in GDP affected the GDP growth in the same way. It is indicating some commonalities with Sri Lanka's economic challenges. Overall, these analyses highlight the diverse economic landscapes of these nations and underscore the importance of specific policy responses to address their unique challenges and foster sustainable economic growth.

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Sustaining Business Operations in the Service Sector

Possibilities and Opportunities for the Resurgence of the Restaurant Industry in an Asian Market in the New Normal: SWOT Analysis and TOWS Matrix

Rabin Mazumder and Pritha Ghosh

Abstract All industries across the globe lacked preparedness for the truculent pandemic scenario. The objective is to identify the internal strengths and weaknesses and external opportunities and threats crucial for an industry's survival and avoid severe impact in future unforeseen crises. The present qualitative study aims to provide possibilities and opportunities for the resurgence of the restaurant industry in an Asian market in the new normal. We conducted semi-structured interviews with 25 participants, analyzed their opinions, and listed factors in an internal factor evaluation matrix (IFEM) and an external factor evaluation matrix (EFEM). The factors were assigned weights and ranks based on priority. Next, we developed the SWOT (strengths, weaknesses, opportunities, and threats) matrix with the sum of the IFEM and EFEM scores. Finally, we created the TOWS (threats, opportunities, weaknesses, and strengths) matrix to formulate various strategies. Analysis of the favorable and unfavorable factors will help us understand how to leverage opportunities with the strengths and how weaknesses can eventually lead to threats. The study will give valuable insights to owners and policymakers for restaurant businesses in Asian markets to discover possibilities and opportunities for a resurgence. In the future, related empirical research on other industries can include the determining elements to build the survey instrument.

Keywords Possibilities · Opportunities · Resurgence · New normal · Restaurant industry · Asian market · SWOT analysis · IFEM · EFEM · TOWS matrix

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Introduction

The two major problems faced by the restaurant industry are recruiting and retaining employees (Yurkevich, 2022). India witnessed a permanent shutdown of 25% of restaurant businesses, which led to the unemployment of 2.54 million people (Sharma, 2021). The restaurant industry was generating profits and employment before the pandemic. Since the beginning of the pandemic in 2020, the industry has started suffering from jobs and economic crises across the globe (Gomes et al., 2022).

The determinant factors that can influence the pricing strategies of the restaurants that survived the coronavirus pandemic are improvements for loopholes in the determinant factors like liquor licensing, workforce, supply chain, and infrastructure (Pal & Aradhya, 2020). There is a positive association between food quality, service, ambience, and overall customer satisfaction for repeat visits to restaurants selling fast food (Rajput & Gahfoor, 2020). Artificial intelligence (AI) and social and other digital media advertisements are essential for developing restaurant industry knowledge (Alkasasbeh, 2020).

Most research on the current topic is from the owners' perspective (Madeira et al., 2021; Sardar et al., 2022) and employees' perspective (Lee & Ham, 2021; Lippert et al., 2021). Therefore, there is a scope to understand the consumers' perspective. Since the start of the pandemic, a lot of impact-based research has been conducted, but it mainly focuses on the travel and hospitality sectors (Kaushal & Srivastava, 2021). Additionally, the majority of research is carried out in developed non-Asian nations (Jafari et al., 2021; Lippert et al., 2021; Madeira et al., 2021). However, developing nations fared worse (Said Al-Mulghairi et al., 2021). Research must therefore focus on Asia's developing economies.

The coronavirus pandemic was destructive, and its vulnerable impact on the restaurant business has research potential (Sardar et al., 2022). A few restaurants had to shut down while the employee lay-offs led to the search for alternative jobs. A guideline will help the restaurant industry's resurgence and sustainable development. Therefore, this study is a humble attempt to explore the industry's strengths, weaknesses, opportunities, and threats and formulate strategies to prepare for future catastrophes. Lippert et al. (2021) explored the occupational stressors of restaurant workers with thematic analysis to find the patterns from data collected from 16 semi-structured interviews of restaurant employees in the US. The five themes identified are fear of getting infected with poor safety policies, insecurity of job, inconsistency in pay and working hours, and unavailability of promising health benefits. Sardar et al. (2022) examined the impact of the COVID-19 pandemic from the restaurant owner's perspective in the emerging economy of Bangladesh. In-depth interviews collected the data to analyze with thematic analysis. The results highlighted that the restaurant owners had to incur additional expenses for social distancing and maintaining hygiene. They had to lay off employees, and despite the boost in home delivery in online platforms, they continue to suffer from a financial crisis. Madeira et al. (2021) examined with content analysis the Portuguese restaurant entrepreneurs' learnings from the pandemic to handle a similar problem in future government measures and

strategies. The highlighted concerns are resilience, proper government measures, design, and working capital availability. In a similar line of research, the present qualitative study aims to clarify the internal and external factors that can drive a change in the restaurant industry from the consumers' perspective in India.

Recent research concentrated on the analysis of the "strengths, weaknesses, opportunities, and threats (SWOT)" for the tourism industry (Fernando, 2020), steel industry (Hesami Arani et al., 2021), and bicycle industry (Xames et al., 2023). The current research seeks "strengths, weaknesses, opportunities and threats" with a SWOT matrix and to identify various strategies with the "threats, opportunities, weaknesses, and strengths (TOWS)" matrix. The findings will help to enhance the performance of the restaurant industry.

The study examines the recovery phase of the restaurant industry in the post-pandemic era that can contribute to the originality and value of extant literature. The study will be helpful to owners and policymakers to understand the current and future marketing trends to update the strategies and policies. It will help improve the restaurant industry's current condition in emerging economies like India. All industries across the globe lacked preparedness for the truculent pandemic scenario. The current analysis of the restaurant industry is crucial for its survival and to avoid severe impact in future unforeseen crises. The study is vital for academicians and managers as any emergency will deteriorate without proper precautions. Practical implications from the findings will be compelling in other pandemics, natural calamities like floods or earthquakes, terrorist attacks, and financial or economic crises like a global recession. The present and future related research will enable owners, managers, and stakeholders to give quick resolutions for financial stability during challenging times.

The following section outlines a process for evaluating the retrospective data provided by participants. The article's uniqueness lies in its genuine account of the participants' viewpoints. The paper ends by discussing the implications and research limitations and proposes a potential avenue for future research.

Literature Review

SWOT Analysis

SWOT analysis can systematically identify the strengths and weaknesses within an industry and monitor the opportunities and threats outside the sector (Harrison, 2010). The strengths of the industry help it achieve its goals, whereas weaknesses pose obstacles to those goals. Opportunities are external advantages the industry can exploit for its benefit, and threats are potential challenges shortly (Kotler & Armstrong, 2018).

TOWS Matrix

TOWS matrix is a framework adopted from findings in the SWOT matrix and can assess and compare data to formulate the appropriate strategy (David & David, 2017; Wheelen et al., 2018). SWOT analysis represents the internal and external factors identified by the participants as data, whereas the TOWS matrix will establish a link between the findings. The TOWS matrix can determine the four strategies: the SO (Strengths Opportunities) strategy, the WO (Weakness Opportunities) strategy, the ST (Strengths Threats) strategy, and the WT (Weakness Threats) strategy. The SO strategy is a primary strategy that will determine a competitive advantage to sustain. The WO strategy aims to overcome weaknesses with opportunities. The ST strategy helps to face external threats with internal strengths. Finally, the WT strategy is a defensive strategy to minimize potential losses (David & David, 2017; Wheelen et al., 2018).

Methods

For SWOT analysis, primary and secondary sources gathered the data. For primary data, the purposive sample consisted of 25 participants. Table 1 presents their credentials. From various newspapers and related research papers, we accessed the secondary data. Following this, we conducted semi-structured interviews with the participants with open-ended questionnaires between March and May 2023. The participants have industrial expertise and are regular restaurant visitors.

Next, a focus group of 6 participants, including two business owners, two industry experts, and two government officers from the sample, was arranged for an in-depth discussion. Several brainstorming sessions by the authors with the data obtained from all three sources of prior research, interviews, and focus groups on identifying the factors for internal strengths and weaknesses and the external opportunities and threats (Anuradha & Sheriff, 2019). Mondal (2017) gave rules that apply to construct the internal factor evaluation matrix (IFEM) and the external factor evaluation matrix (EFEM) in Tables 2 and 3, respectively.

For both IFEM and EFEM, each factor was assigned a weight from 0 (least important) to 1 (most important). The sum of the weighting coefficients given to all factors equals 1. For IFEM, each element was rated 1–4; 1 represents major weakness, 2 represents minor weakness, 3 represents minor strength, and 4 represents major strength. For EFEM, 1 represents a major threat, 2 represents a minor threat, 3 is a minor opportunity, and 4 is a major opportunity. Next, for both IFEM and EFEM, the weighted rating for each factor was calculated by multiplying the weight and the rating in MS Excel. We found the total weighted rating by adding the weighted rating for all the internal factors in IFEM and external factors in EFEM. We implied the decision rule by which, for IFEM, if the total weighted rating is more than 2.5, it means the strengths outweigh the weaknesses and vice versa.

Table 1 List of credentials and their experts

Serial number	Designation	Years of experience	Affiliated organization
1	IT employee	17	Multinational corporation (MNC)
2	Dentist	15	Private clinics and associated hospitals
3	Civil engineer	14	Public sector
4	Therapist	5	Skin clinic
5	Professor	27	Government college
6	Doctor	42	Private clinics and associated hospitals
7	Accountant	36	Private firm
8	Lawyer	43	Corporate
9	Hairstylist	10	Salon
10	Retired school teacher	35	Government school
11	Auditor	38	Private firm
12	Retired government employee	40	Insurance company
13	Physiotherapist	7	Hospital
14	Vice-president	26	Investment bank
15	Branch manager	3	Private bank
16	Senior manager	8	Private firm
17	Businessman	41	Owner of business
18	Journalist	16	Leading magazine
19	Chartered accountant	32	Private firm
20	Architect	27	Owner of business
21	Businessman	32	Owner of business
22	Relationship manager	13	Private bank
23	Policymaker	19	Government
24	School teacher	15	School
25	Financial analyst	10	MNC

Similarly, for EFEM, if the total weighted rating is greater than 2.5, it indicates that the opportunities outweigh the threats (Gurel & Tat, 2017). Finally, the IFEM and EFEM scores prioritized the factors based on their weighted ratings, and a SWOT table was developed in Table 4, a basis for quantitative research. The internal and external analysis helped determine the TOWS matrix strategies in Table 5.

Table 2 Internal factor evaluation matrix (IFEM)

Strengths	Weight	Rating	Weighted rating
Quality of food and beverages	0.08	4	0.32
Pricing and value for money	0.07	4	0.28
Speed and efficiency of service	0.07	4	0.28
Constant innovation and creativity in the menu offerings	0.02	3	0.06
Online ordering and delivery options	0.06	4	0.24
Customer service and staff friendliness make the customers welcoming	0.05	4	0.2
Ambience and atmosphere	0.05	4	0.2
Special promotions and discounts	0.05	4	0.2
Accessibility and convenience	0.04	4	0.16
Environmental sustainability efforts	0.04	4	0.16
Weaknesses			
Inadequate safety measures include a lack of social distancing or adherence to sanitation protocols	0.03	1	0.03
Poor online presence leads to limited digital ordering options	0.04	1	0.04
Slow and inefficient service in the context of delivery or takeout orders	0.05	2	0.1
Unresponsive or unhelpful customer support	0.05	2	0.1
Limited or unappealing menu options. No options for consumers with dietary restrictions or preferences	0.02	1	0.02
Inconsistent food quality or taste	0.07	2	0.14
Excessive pricing without commensurate value	0.06	2	0.12
Negative reviews or poor reputation regarding hygiene or customer experiences can impact the business	0.05	2	0.1
Lack of accommodation for special requests or dietary restrictions	0.01	1	0.01
Failure to adapt to changing consumer expectations and preferences in the post-pandemic era	0.09	2	0.18
	1		**2.94**

Results and Discussion

The data were analyzed using open and axial coding, following the procedure defined by Corbin and Strauss (1990). Two coders coded separately and compared the findings, followed by a direct comparison of the codes, and then we compiled the agreements and disagreements. The initial codes were identified in the data, followed by evaluating the degree of similarity among these codes. Cohen's kappa coefficient measures the level of agreement beyond chance agreement (Cohen, 1960). Based on guidelines provided by Altman (1999) and adapted from Landis and Koch

Table 3 External factor evaluation matrix (EFEM)

Opportunities	Weight	Ratings	Weighted ratings
To utilize social media and digital marketing to reach a wider audience	0.07	4	0.28
To embrace technology for seamless online ordering and delivery experiences	0.05	3	0.15
To offer unique and innovative menu items to stand out	0.05	3	0.15
To provide exceptional customer service and personalized experiences	0.03	3	0.09
To create engaging loyalty programs and incentives	0.04	3	0.12
To collaborate with local influencers and businesses for cross-promotion	0.04	3	0.12
To establish solid partnerships with suppliers for consistent quality ingredients	0.05	3	0.15
To emphasize sustainable and eco-friendly practices	0.07	4	0.28
To incorporate experiential elements, such as live entertainment or themed events	0.03	3	0.09
To implement effective customer feedback mechanisms for continuous improvement	0.08	4	0.32
Threats			
Increased demand for plant-based and vegan options as healthy alternatives for the fitness enthusiasts	0.03	1	0.03
Cater to the growing popularity of cloud kitchens and delivery-only concepts	0.04	1	0.04
Rise of contactless dining experiences and digital menus	0.03	1	0.03
Need to focus on locally sourced and sustainable ingredients	0.08	2	0.16
Need for implementation of the integration of technology for online reservations and table management	0.03	1	0.03
The surge in demand for outdoor dining spaces and al fresco experiences can lead to a breach of safety protocols	0.03	1	0.03
Expansion of food delivery platforms and third-party aggregators can dilute the brand image of the restaurants if the customers are dissatisfied	0.09	2	0.18
The emergence of virtual cooking classes and culinary experiences can harm the restaurant business as people can cook restaurant-like food at home	0.03	1	0.03
Demand for healthier menu options and transparent nutritional information	0.04	1	0.04
Integration of artificial intelligence for personalized recommendations and efficient operations	0.09	2	0.18
	1		**2.5**

Table 4 SWOT analysis of the restaurant industry in Kolkata

Internal factors	
Strengths	Weaknesses
Quality of food and beverages	Inadequate safety measures include a lack of social distancing or adherence to sanitation protocols
Pricing and value for money	Poor online presence leads to limited digital ordering options
Speed and efficiency of service	Slow and inefficient service in the context of delivery or takeout orders
Constant innovation and creativity in the menu offerings	Unresponsive or unhelpful customer support
Online ordering and delivery options	Limited or unappealing menu options. No options for consumers with dietary restrictions or preferences
Customer service and staff friendliness make the customers welcoming	Inconsistent food quality or taste
Ambience and atmosphere	Excessive pricing without commensurate value
Special promotions and discounts	Negative reviews or poor reputation regarding hygiene or customer experiences can impact the business
Accessibility and convenience	Lack of accommodation for special requests or dietary restrictions
Environmental sustainability efforts	Failure to adapt to changing consumer expectations and preferences in the post-pandemic era
External factors	
Opportunities	Threats
To utilize social media and digital marketing to reach a wider audience	Increased demand for plant-based and vegan options as healthy alternatives for the fitness enthusiasts
To embrace technology for seamless online ordering and delivery experiences	Cater to the growing popularity of cloud kitchens and delivery-only concepts
To offer unique and innovative menu items to stand out	Rise of contactless dining experiences and digital menus
To provide exceptional customer service and personalized experiences	Need to focus on locally sourced and sustainable ingredients
To create engaging loyalty programs and incentives	Need for implementation of the integration of technology for online reservations and table management
To collaborate with local influencers and businesses for cross-promotion	The surge in demand for outdoor dining spaces and al fresco experiences can lead to a breach of safety protocols

(continued)

Table 4 (continued)

External factors	
Opportunities	Threats
To establish solid partnerships with suppliers for consistent quality ingredients	Expansion of food delivery platforms and third-party aggregators can dilute the brand image of the restaurants if the customers are dissatisfied
To emphasize sustainable and eco-friendly practices	The emergence of virtual cooking classes and culinary experiences can harm the restaurant business as people can cook restaurant-like food at home
To incorporate experiential elements, such as live entertainment or themed events	Demand for healthier menu options and transparent nutritional information
To implement effective customer feedback mechanisms for continuous improvement	Integration of artificial intelligence for personalized recommendations and efficient operations

(1977), Cohen's kappa (κ) of ($p < 0.0005$) was evaluated as 0.742, which represents a substantial agreement.

In Table 2, the total weighted rating of the internal factors is 2.94 and greater than 2.5, depicting that the strengths outweigh the weaknesses and that the industry is in a strong internal position.

Similarly, in Table 3, the total weighted rating of the external is 2.5, indicating that there is scope for improvement in the strategies to exploit the current opportunities to combat or decrease the adverse impact of the threats outside the industry. Finally, we developed the SWOT matrix in Table 4.

Table 5 presents the TOWS matrix that summarizes the restaurant industry's environmental analysis results and the proposed adaptation strategies.

The ability of the present study to recognize the restaurant industry's need to be more economical and sustainable is an important conclusion.

Following the pandemic, customers have been drawn to the restaurants by the chance to reconnect with old friends, enjoy the environment, and try new foods. An Indian city is the subject of the study. Indians view food as an emotion. They have a strong affinity for eating. They must therefore temporarily avoid eating at restaurants. Only when dining in can we enjoy certain foods, such as hot soups and Indian bread. The populace had grown weary of the months-long lockdowns. The participants said that they wanted to go out and that going to a restaurant made them feel good and refreshed. However, there are still challenges that the eateries must overcome in order to conduct business as usual. The consumers have changed obviously. They are more demanding and alert. People at home improved their cooking abilities during the lockdown by learning new recipes that are simple to prepare using contemporary equipment that is easily accessible online. Humans are adaptable creatures. On weekends or special occasions, they have started unwinding and catching up with friends and family over home-cooked or meals ordered online. There has clearly

Table 5 Restaurant industry TOWS matrix

TOWS matrix	Strengths (S)	Weaknesses (W)
	Quality of food and beverages	Inadequate safety measures include a lack of social distancing or adherence to sanitation protocols
	Pricing and value for money	Poor online presence leads to limited digital ordering options
	Speed and efficiency of service	Slow and inefficient service in the context of delivery or takeout orders
	Constant innovation and creativity in the menu offerings	Unresponsive or unhelpful customer support
	Online ordering and delivery options	Limited or unappealing menu options. No options for consumers with dietary restrictions or preferences
	Customer service and staff friendliness make the customers welcoming	Inconsistent food quality or taste
	Ambience and atmosphere	Excessive pricing without commensurate value
	Special promotions and discounts	Negative reviews or poor reputation regarding hygiene or customer experiences can impact the business
	Accessibility and convenience	Lack of accommodation for special requests or dietary restrictions
	Environmental sustainability efforts	Failure to adapt to changing consumer expectations and preferences in the post-pandemic era

Opportunities (O)	SO strategy	WO strategy
To utilize social media and digital marketing to reach a wider audience	Online platforms and third-party delivery services will allow restaurants to get a broader customer base and increase revenue streams	Restaurants can streamline kitchen operations and reduce wait times
To embrace technology for seamless online ordering and delivery experiences	A restaurant's reputation for its cuisine, service, and overall dining experience can play a significant role in attracting customers	Restaurants can enhance inventory management to minimize food waste
To offer unique and innovative menu items to stand out	Restaurants should strive to provide special menu items, creative presentations, or distinct dining concepts that differentiate them from others	They are implementing practical staff training and communication protocols
To provide exceptional customer service and personalized experiences	Consistency in food quality is crucial for customer satisfaction and loyalty	They are embracing technology for efficient order-taking and payment processing

(continued)

Table 5 (continued)

Opportunities (O)	SO strategy	WO strategy
To create engaging loyalty programs and incentives	Restaurants should establish standard recipes, train their kitchen staff on proper food preparation techniques, and regularly monitor the quality of ingredients	Restaurants must improve their online presence and digital marketing strategies
To collaborate with local influencers and businesses for cross-promotion	Conducting routine quality checks and soliciting customer feedback can help identify areas for improvement	Restaurants must make efforts to strengthen customer feedback and response mechanisms
To establish solid partnerships with suppliers for consistent quality ingredients	Excellence in marketing and branding can create a strong identity and attract a loyal customer base. Therefore, it includes developing a compelling brand story, consistent visual branding, targeted advertising campaigns, and collaborations with influencers or local organizations to increase visibility	Restaurants must enhance delivery logistics and packaging solutions
To emphasize sustainable and eco-friendly practices	Restaurants must adapt their operations to cater to the growing trend for online demand by optimizing packaging for delivery, and partnering with third-party delivery platforms can benefit from this trend	Restaurants must invest in sustainable and energy-efficient practices
To incorporate experiential elements, such as live entertainment or themed events	The economic impact of the pandemic has made customers more conscious of their spending. Restaurants that have raised prices without offering perceived value or have not adjusted their prices to meet the current economic climate may face challenges in attracting customers	Restaurants must implement robust hygiene and sanitation protocols

(continued)

Table 5 (continued)

Opportunities (O)	SO strategy	WO strategy
To implement effective customer feedback mechanisms for continuous improvement	Restaurants are implementing tabletop technologies such as tablets or touchscreen devices at tables, allowing customers to browse menus, place orders, and even pay their bills directly. This technology enhances the dining experience, improves order accuracy, and reduces customer waiting time	Restaurant managers must emphasize teamwork and foster a positive work culture

Threats (T)	ST strategy	WT strategy
An increase in demand for plant-based and vegan options as healthy alternatives for the fitness enthusiasts	Advancements in artificial intelligence for personalized customer recommendations and automated order processing	Implementation of stricter hygiene and sanitation guidelines
Cater to the growing popularity of cloud kitchens and delivery-only concepts	Integration of robotics for automated food preparation and delivery systems	Increased focus on food safety inspections and certifications
Rise of contactless dining experiences and digital menus	Enhanced online ordering platforms with advanced customization options and seamless payment processing	Enhanced regulations for food labeling and transparency
Need to focus on locally sourced and sustainable ingredients	Contactless payment systems and digital wallets for a seamless dining experience	Support for local and independent restaurants through financial incentives and grants
Need for implementation of the integration of technology for online reservations and table management	Virtual and augmented reality technologies for immersive dining experiences or virtual menu exploration	Expansion of outdoor dining spaces and relaxation of zoning restrictions
The surge in demand for outdoor dining spaces and al fresco experiences can lead to a breach of safety protocols	Advanced analytics and data-driven insights for better decision-making and customer understanding	Incentives for sustainable and eco-friendly practices include reduced composting or energy-efficient equipment taxes
Expansion of food delivery platforms and third-party aggregators can dilute the brand image of the restaurants if the customers are dissatisfied	Integration of voice assistants and chatbots for efficient customer support and order management	Enhanced worker protection and labor rights regulations

(continued)

Table 5 (continued)

Threats (T)	ST strategy	WT strategy
The emergence of virtual cooking classes and culinary experiences can harm the restaurant business as people can cook restaurant-like food at home	The expansion of delivery drones and autonomous vehicles will lead to efficient and eco-friendly food delivery	Promotion of healthier menu options through nutritional labeling requirements
Demand for healthier menu options and transparent nutritional information	Blockchain technology can enhance traceability and transparency in the food supply chain	Availability of streamlined licensing and permit processes for small-scale food businesses
Integration of artificial intelligence for personalized recommendations and efficient operations		Support for technology integration and digital solutions to improve efficiency and customer experiences
		Governments may introduce stricter health and safety guidelines for restaurants to prevent future outbreaks. These regulations could lead to increased cleanliness standards and improved food handling practices, which would enhance customer confidence and trust in the industry

been less of a rush to eat at eateries. Restaurant owners and managers continue to struggle with getting consumers to return. Hygiene and safety protocols have to be adhered to like never before. To date, restaurants with experience and reputations are trusted and preferred by consumers. But menu redesigning is suggested to attract new consumers.

Younger generations are drawn to start-ups like new-age cafeterias and oven-based restaurants. Therefore, in order to establish themselves in the market, startups must provide excellent meals. Before going to a restaurant or placing an order, the younger generation emphasises the value of reading customer reviews. Younger participants have frequently cited the staff's conduct as the reason for their frequent restaurant visits. Owners and managers are responsible for hiring and training employees who will act courteously and amiably even in challenging circumstances. Compared to older generations, the younger ones are far too sensitive. They are looking for better options like vegan and dairy-free meals, as well as vegetables and grains, because they are more health-conscious now that the pandemic has passed. They avoid eating a lot of fast food, such pizza or hamburgers. They are the impatient age, and they detest waiting for long periods of time, according to another observation. They are intelligent consumers who are constantly searching for deals and discounts. Another critical factor that restaurant managers must handle is quick delivery for dine-in and

online orders. A separate takeaway counter has been suggested by participants as being beneficial for those who wish to take parcels. The influence of food vloggers on social media and YouTube encourages people to try new foods. Therefore, menu diversity is something that restaurant owners can look for. To draw customers, startups can even create food from different states. Following the pandemic, several people were able to start small enterprises that deliver home-cooked food online.

Online delivery was a notable advance in the restaurant industry. Prior to the epidemic, the restaurants were not accessible online. However, they began delivering food to maintain their operations. They continue to do so for sustenance, much to the delight of the customers. Restaurants that previously only delivered within a 3 km radius now offer delivery up to 10 km away. Zomato has begun offering interstate delivery. Few individuals mentioned that their family members and friends had favourable experiences ordering cuisine from their city. Customers' faith in delivery applications like Swiggy and Zomato has grown over time. For starters, buyers have discovered social media marketing, which failed well before the pandemic due to the lack of promotions and advertisements. Startups have incorporated international cuisine and enlisted the help of social media influencers to advertise their brands. Today, food vlogging is a career that supports many people's incomes. However, it can be detrimental because, with a partnership, food vloggers can heavily advertise extremely ordinary food, misleading their viewers or subscribers. To fully realise their potential, start-ups must locate their eateries in heavily trafficked areas and analyse the advantages and disadvantages of each rival. Start-ups in India, particularly in Kolkata, which is known for its traditional cuisine, must offer amazing food in order to be accepted.

Online delivery and packaging innovation are major discussions in the post-pandemic period. Threats do exist, though. The use of outside delivery services can damage a restaurant's reputation. Customers can occasionally become irritated by excessive delays brought on by incorrect food handling, unpleasant behaviour, or the lack of GPS information needed to arrive at the destination with frequent calls to the customer. As a result, the delivery guys need to receive proper training. Additionally, the steady rise in taxes and delivery fees levied by delivery apps might drive up the overall price of the food and turn away customers. Free delivery has been suggested by the participants. Participants also stressed the importance of packing, which they find appealing in online delivery. If the packaging is good, there are fewer chances of spillage, and also easy to open after complete delivery. The burden is that the footfall has considerably reduced. A probable reason could be the discounts and offers in online channels. Therefore, if the restaurants can provide similar price benefits to consumers, then some online customers will return to restaurants.

Another practice observed by participants is that the restaurants have reduced the portion size and increased the prices. We highly discourage this act as customers are astute, which will only create angst among them. It is best to sustain and revive with sincere efforts.

Quality and competitive pricing are the keys to sustenance. Adaptability to online servers, cloud kitchens, and artificial intelligence will help the maintenance. Asian

markets will take longer than others to adapt to the new technologies. Restaurants depending on traditional methods will face hindrances. Competition among the competitors will pose a threat soon.

Conclusion

The current study is one of the first to develop a SWOT and a TOWS matrix associated with the restaurant industry in the post-pandemic era. The COVID-19 pandemic crisis was an unforeseen external threat that shocked businesses across the globe. The study's findings to control are not restricted to internal evaluation but also to the interactions outside the industries, for which we adopted SWOT analysis in the current study. The study examined internal and external factors for appropriate strategies in the TOWS matrix to develop preventive and recovery measures for the industry. The disruptions caused by the pandemic can be short-lived, with the beginning of new trends and patterns of outside food consumption. The findings suggest that learning new skills and practices can eventually lead to the resurgence and sustenance of the restaurant industry in Asian markets.

The present study contributes to the extant literature by exploring factors from the consumers' perspective, which is crucial in developing policies and formulating marketing strategies. Existing literature supported the elements, and a quantitative study could create and validate a conceptual model. Impact-based research on COVID-19 on the restaurant industry needs to be more saturated and could substantially contribute to tourism development.

The tourism and hospitality sector substantially contribute to a country's economy. The various subsectors of the tourism and hospitality industry are airlines, railways, hotels, and restaurants, and the subsectors require immediate attention for revival. The strategies will help the restaurants recover and prepare for the unforeseen future. Restaurants should consider the consumers' diversity and use social media to their advantage. There should be maintenance of the wellness of the consumers and contactless services. Owners must seek professional help for food, advertisements, or safety protocols. Present and similar research will give the owners insights into the current study's findings and help them build theories for managing and marketing restaurants for restoration. The present study's findings highlight the roles of social media and artificial intelligence, which are important topics for research for business owners, policymakers, and marketers.

They are leading the discussion with the participants toward brainstorming for identification and rapid scoring of the factors that contributed to the SWOT matrix's effectiveness. But the limitation of being time-consuming was observed, in prioritizing the factors, for developing the SWOT matrix and defining the strategies for the TOWS matrix. Also, the perception of readers may vary with the findings. Since the research is focused only on one city in India, we cannot generalize the results. Therefore, future research can extend the study to other areas. The scope of the study is small and does not represent all the consumers' opinions. There is a possibility

of factors remaining unidentified in the survey. The current research only considers the views of consumers in the questionnaire. The perspectives of owners, managers, present and laid-off employees, and stakeholders can vary. The present study is qualitative and not statistically validated. The sample represents a small section of restaurant-goers in major urban areas. Therefore, selection biases may have influenced their opinions. Owing to the narrow scope of the study, although the sample size was small, we attained theoretical saturation. Also, to capture the lived responses from the restaurant-goers immediately after the pandemic, the data collection was done in a limited time frame, which might impact the theoretical saturation.

Despite the research limitations, the current study is among the few qualitative studies documenting restaurant-goers' experiences after the pandemic. Unlike quantitative analysis, a qualitative approach can describe the social context by reporting their psycho-social responses.

Future studies can overcome the limitations of the current study. They can conduct a longitudinal study to examine the resurgence and sustainable development of the restaurant industry in an Asian market. Researchers must explore ways restaurants can collaborate with government agencies for mechanisms for coordination and make plans for comprehensive crises.

The current study took learnings from the current scenarios to provide managerial recommendations on future crisis management of the restaurant industry. The findings will have implications for the resurgence and sustainable development of the restaurant industry in an Asian market in response to the changing needs of its consumers.

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Does Brand Love Increase Consumer Engagement and Brand Equity in Social Media Platforms? Structural Equations Approach

Fedric Kujur, Anirban Mandal, Sriparna Guha, and Saikat Chakrabarti

Abstract Businesses need customers to have positive feelings about their products to succeed, and this may be achieved by cultivating a loyal fan base that views the company's brand as superior to the competition. The current research has tried to identify several variables that contribute to brand devotion. Furthermore, the impact of brand loyalty on online engagement and credibility is investigated. Data was obtained offline using a standardized questionnaire from 510 participants who have followed at least five brand pages on Facebook. Structural Equation Modelling (SEM) was used as an approach for data analysis. There was a favourable and statistically significant relationship between the appraisal of brand love and consumer participation, brand confidence, and brand love itself. There is a growing corpus of literature on brand loyalty, and this study adds to it by exploring the role of the customer in creating an emotional connection to a brand.

Keywords Brand love · Consumer engagement · Brand equity · Social media · Social networking site

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Introduction

In the modern dynamic economy, manufacturers have shifted their focus to customer happiness by offering the best service that they can concerning the product or brand that customers buy. The concept of emotional bonding which is beyond satisfaction came into light to gain customer loyalty toward the brand. According to Kujur and Singh (2020), "undivided brand loyalty" is crucial in creating a strong connection with consumers on an emotional level, leading them to view the brand as superior to competitors. In addition, these buyers are the most devoted to the company since they believe the product will continue to fulfill their requirements.

With the technological advancement in recent times, social media emerged as an important communication tool for connecting customers and brands with its dynamic and interactive features (Guha et al., 2021). Companies in big numbers are going for social media presence by creating brand pages on Social Networking Sites (SNS) because this process enables companies to have direct interactions with social media users and convey their brand-related messages to them on a one-to-many and many-to-many basis which subsequently influences the development of a strong relationship with their fans and followers. Many scholars (Hanafizadeh & Shafia, 2021; Wallace et al., 2017) argue that the "like" function of Facebook pages represents customers' emotional connections to brands they follow on the platform, and thus serves as an affirmation of customers' love for those brands. A small but growing body of research suggests that content created by e-marketers and user-generated customer reviews in SNS have a significant impact on consumers' propensity to make a purchase (Chen et al., 2014; Sedalo et al., 2022). As a result, social media plays a crucial role in converting customers into brand devotees (Hafez, 2021; Pavlovi-Höck, 2022).

Brand love is comparatively a popular domain in marketing theory which has grown fast in the current context and is continuously being explored by marketers (Madeline & Sihombing, 2019). The purpose of this research was to identify the factors that make consumers loyal to particular brands, as this quality is crucial for businesses to thrive in today's cutthroat business environment. Additionally, the study delves into how brand loyalty affects consumer involvement on social media and brand equity.

Review of Literature

Concept of Brand Love

Historically, people have believed that there is more to the bond between customers and companies and its branded product ranges, than just a simple preference. Brand love is a more general notion in the branding literature, and it is based on the triangular theory of love (Madeline & Sihombing, 2019; Zhang et al., 2020; Casais & Pereira, 2021). Based on the triangular model of love, Ahuvia (2005) proposed three

dimensions of brand passion: cognitive love for a brand, affective brand affection, and connotative love for a brand. affection for a brand can persuade a customer that it is superior to competitors, strengthen the connection among the two parties over the long term, foster a belief in the brand, and lead to a higher rate of customer retention (Hafez, 2021). The brand lovers become completely committed and loyal and tend to create a favorable word of mouth and recommend the brand and this may lead to ignore small mistakes or defects occurring in the brand (Ferreira et al., 2019). Literature on brand love (Bigne et al., 2020; Ferreira et al., 2019; Wallace et al., 2017) has discussed the importance of brand recognition, brand loyalty, WOM, consumer-brand relationship, marketing, and purchasing preferences, and decreased price responsiveness to improve positive feelings and perceptions towards the brand.

Social media has provided added value to the marketing information in reaching and convincing many media users, subsequently leading to emotional brand attachment as a result of continuous interactions between consumers and brands (Hafez, 2021; Tran et al., 2020). In this study, we break down the origins of brand loyalty into two categories: brand-related and customer-related. We then look at how these two categories interact with one another in the Indian context, including the impact of digital platforms. Affective brand experience, self-expressive brand, hedonic product, and brand image are all aspects associated with brands. Conversely, factors about customers encompass their impressions of value, quality, and price concerns related to brands.

A product or service's perceived quality is the customer's own opinion of how good it is. There is no guarantee that this subjective criterion will correspond with the actual product quality. Raw materials, production methods, warranty, and after-sale assistance are only a few of the tangible aspects that contribute to objective quality (Tran et al., 2020). The term "perceived value" describes how customers feel about a product or service, especially when contrasted with similar offers from other companies. The determination of perceived value is based on the monetary amount that individuals in the general population are willing to exchange for a certain commodity or service (Tran et al., 2020). On the other hand, perceived price consciousness refers to the extent to which consumers possess knowledge of the prices of the things they intend to acquire, as well as the costs of alternative products, with a primary emphasis on obtaining the most favourable price for their intended purchases (Hafez, 2021).

Brand-Related Variables Affecting Brand Love

Brand-related variables are primarily concerned with the marketing practice for identifying a product and distinguishing it from other products and services.

Affective Brand Experience

To generate a wide range of emotions related to a brand, from somewhat optimistic sentiments to intense feelings of joy and pride, marketers use what Park (2015) calls "affective brand experiences," which they define as marketing appeals to the internal mental and emotional states of customers. Companies focus not only on satisfying consumers by meeting their needs but also on providing them with a pleasant experience. Because of this bond, consumers are more likely to remain loyal despite operational errors (A-Qader et al., 2017; Demmers et al., 2020; Zhang, 2019; Demmers et al., 2021).

In addition, studies have shown that consumers are not just buying products and services anymore (Nguyen et al., 2014; Park, 2015; Singh et al., 2021). Customers are more likely to learn about, use, and interact with a product or service positively and productively if they have a positive experience with it (Cleff et al., 2018; de Oliveira Santini et al., 2020). When consumers have a strong emotional connection to a brand, they are more likely to pay a premium for its products or services. Therefore, this study presupposes that customers would be more loyal to a brand after a positive emotional connection with it. Therefore, the proposed hypothesis is:

H1: Brand love is positively influenced by an affective brand experience.

Brand Image

For customers, "impressions and ideas" about a brand are a consequence of "subjective and sensory processes" (Tran et al., 2020). A consumer's perception of a brand is not contingent on whether or not they have actually used the product or service in question (Ansary & Hashim, 2018; Joshi & Garg, 2021). It has long been acknowledged in the marketing literature that a favourable customer perception of a brand can have a significant impact on sales when consumers talk favourably about it to others. Customers who have a favourable experience with a brand are more likely to talk about it favourably with others, giving marketers a unique opportunity to learn about customer preferences (Hsieh & Li, 2008). Creating a distinct identity for a product or service helps consumers choose it over similar options (Bilgin, 2018; Cheung et al., 2019; Savitri et al., 2022). Thus, the proposed hypothesis is:

H2: Brand Image has a positive impact on Brand Love.

Hedonic Product

The buying behavior of consumers is always influenced by either a hedonic attitude or utilitarian attitude or both (Bigne et al., 2020). From the research finding, it can be inferred that preferred brands are frequently seen in those categories in which the products are purchased on a hedonic way than those products that are categorized as utilitarian products (Sarkar, 2014). It is because love is a powerful emotional experience and has high intensity in both interpersonal love and consumer behavior (Lin

et al., 2018). Basically, hedonic products include those products whose primary benefit is fun, pleasure, or enjoyment. The study suggests that better emotional responses can be generated in the case of hedonic products (Yu & Yuan, 2019). It is also observed that the hedonic products and brand love has a positive connection (Chatterjee et al., 2021; Sarkar, 2014). Therefore, the proposed hypothesis is:

H3: Hedonic Product has a positive impact on Brand Love.

Self-Expressive Brand

Ahuvia (2005), defines a self-expressive brand as "the customers' perception of the degree to which the specific brand enhances one's social self and/or reflects one's inner self". The functions of a self-expressive brand mostly center on the construction and maintenance of the identity of the brand. "Brand love was higher in the brand that reflected the self"- confirmed by Ahuvia (2005), Wallace et al. (2017), Algharabat (2017); Wallace et al. (2021). Additionally, if the brand represents the self (person's identity), successful word-of-mouth communication is often accomplished (Bai et al., 2021). In this respect, the present study assumes that self-expressive brands will have a positive impact on brand love. Thus, the proposed hypothesis is:

H4: Self-expressive Brand has a positive impact on Brand Love.

Customer-Related Variables Affecting Brand Love

Customer-related variables are primarily concerned with measuring customers' perceptions about a particular brand.

Perceived Quality

Perceived quality is consumers' product evaluation. While using a particular product, the customer evaluates the performance of the product which further provides more insight into whether the brand offers quality for price that makes them want to keep doing business with the company. Madadi et al. (2021) found in the services sector that companies are seeking to distinguish themselves by offering greater service efficiency, and higher value and building brand image to create long-term relationships with their customers.

The present research assumes that the evaluation made by consumers on the performance of a brand shapes either a favorable or an unfavorable attitude toward the likeability perception of the brand. This research considers the need to have an appropriate degree of product / service quality as the key determinant of brand likability (Lin et al. 2018). Nguyen et al. (2013 and 2014) state that likeness for a brand is a prerequisite to brand love; because in interpersonal relationships, two individuals usually go through a cycle of like (attraction) to love (intimacy, commitment, and

passion). Yang (2010) also asserts that the qualitative dimension of any product/service does exert positive feelings (love) for the brand. Thus, the present study expects a positive relationship between perceived quality and brand love. Therefore, the proposed hypothesis is:

H5: Perceived quality has a positive impact on brand love.

Perceived Value

The perceived value of a product, service, or piece of information is defined by Kujur and Singh (2018) as "the customer's overall evaluation of the product, service, or piece of information based on their perceptual judgment between benefit and cost." According to recent research (Bairrada et al., 2019), customers' perceptions of a product's worth are a key factor in changing their buying patterns and other routines. Consumers are more loyal to a brand if they are satisfied with it, as evidenced by previous research (Algharabat et al., 2020; Bagozzi et al., 2017; Hanafizadeh & Shafia, 2021). According to studies like Bagozzi et al. (2017), Hegner et al. (2017), and Tiwari et al. (2021), consumers develop strong feelings of loyalty towards a brand when they consider it to be of good quality. As a result, the present research anticipates a causal link between value perception and brand loyalty. Therefore, the proposed hypothesis is:

H6: Perceived value has a positive impact on brand love.

Perceived Price Consciousness

According to Nguyen et al., 2014, "price consciousness is the degree to which the customer focuses exclusively on paying low prices". Literature indicates from a customer-economical viewpoint that greater price cuts contribute to a more optimistic attitude towards brands (Bigne et al., 2020). Lin et al. (2018) state that if consumers expect greater price savings by purchasing private-label brands, they can have a more favorable outlook toward them. Nguyen et al. (2014) also confirm in their study that a lower price for a brand or price consciousness contributes to a more optimistic disposition toward the brand's likeability. They further explain that a brand perceived as high quality product with a lower price affects both the cognitive and affective dimensions of customers leading to emotional attachment with that brand. Hence, using a similar line of reasoning, the present study assumes that the lower the price (or the lesser the price consciousness) will create more positive attitudes and feelings towards the brand. Therefore, the proposed hypothesis would be:

H7: Lesser price consciousness will have a positive impact on brand love.

Consumer Engagement via SNS

Consumer engagement through social networking sites (SNS) can be characterised as a psychological state encompassing emotional, cognitive, and behavioural aspects (Brodie et al., 2011). In the realm of social networking, customer responses or engagement are commonly assessed by metrics such as comments, followers, subscribers, shares, likes, and posts, among others. The growing number of social media participations among consumers has triggered the emergence of the customer engagement concept. According to Hollebeek (2011), consumer engagement (CE) is expressed as "the level of a customer's cognitive, emotional and behavioral investment through continuous interactions with a specific brand". Customer engagement is a relatively new phenomenon that very often results in WOM which can act as the dominant force in shaping consumer purchase behavior and can transform people from passive consumers to active consumers (Fu et al., 2015; Pezzuti et al., 2021). All the activities which are carried out under customer engagement provide some tools for relationship-based marketing strategies which bridge the gap between consumer and brand and establish a new relationship paradigm (Hanafizadeh & Shafia, 2021).

The Facebook Brand Pages (FBP) are followed by Facebook users who like the brand page, indicating that they are interested in receiving brand-related information and interacting with the brand. This process leads to the automatic posting of brand-related information in the form of anecdotes, statuses, photos, and videos in the personal Facebook newsfeed of the users where they interact with the brand by means of likes, comments, and shares (Hanafizadeh & Shafia, 2021). Early research findings have shown that social media technology has succeeded in making brands famous with diverse marketing agencies among social media users increasing higher rates of engagement between consumers, brands, and e-WOM (Chu & Sung, 2015; Gensler et al., 2013; Sedalo et al., 2022; Zhang et al., 2020).

Brand Love and Consumer Engagement Through SNS

Word-of-mouth (WOM), website visits, and product purchases all fall under the category of " proactive engagement," whereas "the brand adoration" has a positive impact on both WOM and commitment to a brand (Kang, 2015; Rahman et al., 2021). Active engagement refers to a consumer's propensity to go above and beyond basic brand maintenance, such as making purchases and using services associated with the brand. Several empirical studies, like Jayasingh (2019), Xu and Cheng (2021), and others, have revealed a positive and substantial link between brand love and consumer involvement behaviour in a social media context. Word-of-mouth (WOM) communication is directly linked to the extent to which a customer informs their friends, colleagues, and acquaintances about items or services that fulfil their requirements. Armelini (2011) discovered that WOM was primarily created as a marketing tool for two specific purposes. Initially, the buyers displayed a diminished level of

interest in the adverts in the conventional media. Furthermore, the influence of word-of-mouth (WOM) has been enhanced by a technological revolution in information and telecommunication, which has reduced the distance and time barriers between persons (Armelini, 2011).

Bae and Kim (2023) assert that customers acquire goods for their utilitarian purposes as well as for the symbolic significance attributed to their pictures. Customers are increasingly seeking social affiliation through the acquisition of particular items. During the process of generating revisit intentions, the authors found that self-image congruence has a considerable impact on cognitive value assessments and contributes to positive emotional experiences. The process of self-image congruency has a significant role in determining the emotional response to a particular business circumstance.

Therefore, the current study concludes that consumers' levels of brand loyalty impact their participation in social media. Therefore, the proposed hypothesis is:

H8: Brand Love has a positive impact on Consumer Engagement in social media environment.

Brand Love and Brand Equity

Based on advertising studies (Gómez and Molina, 2015; Stojanovic et al., 2018), consumer trust in a brand is one of among the most significant and essential parts of brand management. In order to build brand equity, a customer must associate a favorable, substantial, and distinguishable set of emotions with a brand (Demmers et al., 2020). According to Madadi et al., (2021), brand equity may be described primarily in two ways. The first is concerned with the monetary aspect of brand equity, while the second is with the marketing communication aspect. Both strategies identify or emphasise a shared aspect of brand equity: the added value gained through the use of a trademark in products or services.

Previous works have demonstrated that brand love is capable of reinforcing and cultivating the strength of customer-brand relationships, improving their trust, and increasing brand confidence (Madadi et al., 2021; Rahman et al., 2021). However, they also highlighted that brand love may also enhance loyalty and intentions to purchase. As brand loyalty is a result of brand love and one of the brand equity elements, brand love would also have a positive impact on brand equity as well (Bae & Kim, 2023; Machado et al., 2019). Therefore: the proposed hypothesis is:

H9: Brand love has a positive impact on brand equity.

Consumer Engagement and Brand Equity

Customer retention refers to the likelihood of a customer being engaged or active with a business or brand (Jain, 2023). When analysing customer retention, word-of-mouth (WOM) has an impact on this concept by influencing the likelihood that a current customer will promote a company's product over the course of their lifetime as a customer. Researchers and practitioners have extensively examined the factors that contribute to client retention or customer loyalty. However, there is still no widespread agreement on the underlying causes. Customer participation also contributes to consumer–brand resonance (Machado et al., 2019). The prior study suggests that SNS consumer engagement promotes brand purchase intentions, meaningful relationships, customer confidence, and loyalty, delivering value for customers and marketers (Madadi et al., 2021). Recent research has demonstrated that customer interaction with brand-related activities on Facebook boosts brand equity. Based on earlier research, this study believes social media customer contact will improve brand equity. Therefore: the proposed hypothesis is:

H10: Consumer engagement has a positive effect on brand equity.

The Fig. 1 shows the framework of the study.

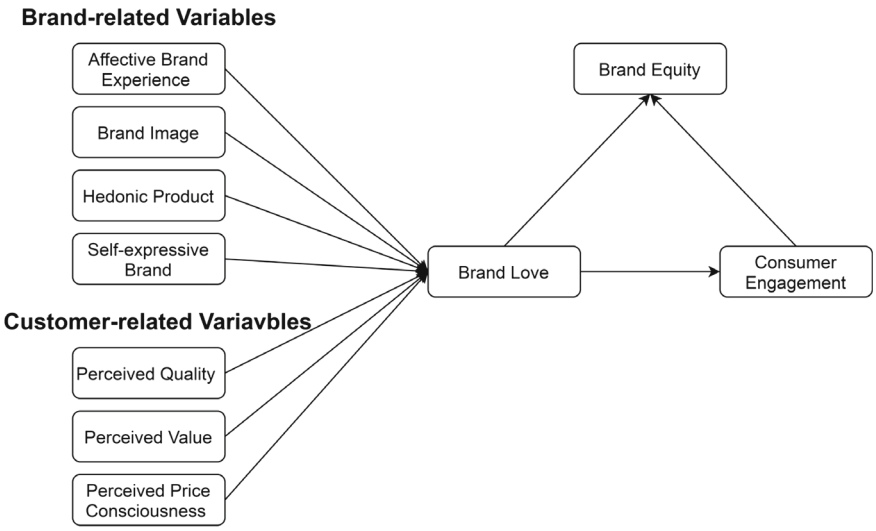

Fig. 1 Conceptual framework of the study

Research Methodology

Sample Selection and Data Collection:

Since the present study was conducted in a social media context, the selection of the sample mainly included the youth population especially the age group between 15 and 30 years old. The target respondents consisted of students of different educational levels and from different higher educational institutions located in India. The youth population for this study was considered best because in India the rate of internet penetration is still highest among the youth population, location especially the students of under-graduation, post-graduation, and Ph.D. students (Kang, 2015). Facebook users were considered as the main respondents for the present study. For the data collection, a structured questionnaire was prepared from the past literature by slightly modifying items to fit the context of the study and was distributed among the eligible students studying in different colleges and universities. The questionnaire survey used only offline mode to reach the respondents. The data collected were properly screened and deleted all the miscoded data entries and eventually only 510 responses were considered fit for the present analysis.

The data collected showed 49.8% male respondents and 50.2% female respondents. Further, 51.0% respondents belonged to the age group between 21 and 25 years, followed by 27.8% between 15 and 20 years and 21.2% between 26 and 30 years. Further, 43.9% of respondents said they use Facebook daily for 2 h, followed by 31.2% for 1 h, 14.5% for 30 min and 10.4% use more than 2 h a day.

Measurement Model

This study utilised a five-point ordinal (Likert) scale ranging from 1 = 'strongly disagree' to 5 = 'strongly concur' to assess the variables. 40 model components were subjected to principal axis factorization to determine the dimensionality of the data. Many variables were condensed into manageable numbers by using the exploratory factor analysis (EFA) method with varimax rotation in SPSS version 21. The review of prior works uncovered scale-based models. Ten individual variables explained 74.987% of the total variance. Ten factors had 35 items, and five were deleted due to low factor loadings (below 0.5). Table 1 displays EFA factor loadings. Confirmatory Factor Analysis (CFA) and Structured Equation Modeling (SEM), using AMOS version 21 statistical software, were respectively applied to evaluate the properties of the scales.

The reliability of the constructs was evaluated using CFA. According to the CFA findings, the hypothesised factor structure was well-represented by the measurement model (Chi-square = 1039.897, CMIN/DF = 2.019, GFI = 0.892, NFI = 0.904, IFI = 0.949, TLI = 0.941, CFI = 0.949, RMSEA = 0.045, RMR = 0.036). Malhotra and Das (2014) suggest using 0.90 for GFI, NFI, IFI, TLI, and CFI, and 0.80 for

Table 1 Constructs and their factor loadings

Constructs	Code	EFA Factor Loadings	CFA Factor Loadings	Cronbach's Alpha > 0.7	CR > 0.7	AVE > 0.5	MSV
Affective brand experience	ABE1	0.953	0.995	0.860	0.945	0.853	0.058
	ABE2	0.941	0.969				
	ABE3	0.870	0.794				
Brand image	BI1	0.873	0.903	0.903	0.851	0.667	0.216
	BI2	0.849	0.944				
	BI3	0.714	0.543				
Hedonic product	HP1	0.822	0.780	0.939	0.795	0.564	0.216
	HP2	0.810	0.733				
	HP3	0.804	0.739				
Self-expressive brand	SB1	0.843	0.830	0.901	0.857	0.601	0.216
	SB2	0.820	0.788				
	SB3	0.783	0.770				
	SB4	0.756	0.708				
Perceived quality	PQ1	0.797	0.711	0.898	0.768	0.524	0.216
	PQ2	0.773	0.724				
	PQ3	0.720	0.737				
Perceived value	PV1	0.812	0.775	0.862	0.825	0.541	0.123
	PV2	0.809	0.751				
	PV3	0.797	0.750				
	PV4	0.725	0.662				
Perceived price consciousness	PPC1	0.839	0.738	0.796	0.780	0.542	0.113
	PPC2	0.813	0.737				
	PPC3	0.771	0.733				
Brand love	BL1	0.879	0.866	0.834		0.730	0.274
	BL2	0.874	0.864				
	BL3	0.869	0.881				
	BL4	0.823	0.805				
Consumer engagement	CE1	0.824	0.768	0.814	0.877	0.641	0.274
	CE2	0.813	0.808				
	CE3	0.800	0.811				
	CE4	0.793	0.815				
Brand Equity	BE1	0.866	0.830	0.872	0.892	0.673	0.120
	BE2	0.858	0.841				
	BE3	0.823	0.816				
	BE4	0.819	0.794				

Source Authors' Calculations

RMSEA and RMR. The CFA measurement model was thus found to be fit. Table 1 displays factor loadings after standardization.

Convergent and discriminant validities make up what is called "construct validity." The results of the concept validity and reliability are presented in Tables 1 and 2, respectively. All of the necessary indices fell within reasonable bounds, indicating strong reliability and high convergent and discriminant validity, as required by the CFA exams. Thus, the measurement model (Memon et al., 2021) can be tested further, perhaps using Structural Equation Modelling (CB-SEM) as is required here.

The authors create a structural model to investigate the association between the research model's constructs. The structural model showed a rather strong model fit, as shown by model-fit indices: (Chi-square = 1575.309, CMIN/DF = 2.864, GFI = 0.829, NFI = 0.855, IFI = 0. 901, TLI = 0. 892, CFI = 0. 900, RMSEA = 0.061, RMR = 0.112). The hypothesized results have been shown in Table 3 and Fig. 2.

From the analysis (Table 3 and Fig. 2), it should be noted that all proposed hypotheses except one (i.e., H7- the relationship between PPC and BL) were found to be supported. Brand-related factors showed a comparatively higher influence on brand love than customer-related variables. From brand-related variables, the self-expressive brand showed high impact ($\beta = 0.246$, $p < 0.05$), followed by brand image ($\beta = 0.199$, $p < 0.05$), affective brand experience ($\beta = 0.178$, $p < 0.05$), and hedonic product ($\beta = 0.146$, $p < 0.05$). Similarly, from customer-related variables, perceived quality ($\beta = 0.107$, $p < 0.05$) and perceived value ($\beta = 0.100$, $p < 0.05$) demonstrated comparatively similar impact on brand love. Further, the influence of brand love on consumer engagement and brand equity was also assessed and the result exhibited positive and significant relationships (i.e., $\beta = 0.211$, $p < 0.05$; $\beta = 0.279$, $p < 0.05$). Lastly, the impact of consumer engagement was measured and for this relationship, the result showed a positive and significant association (i.e., $\beta = 0.288$, $p < 0.05$).

Table 2 Inter-construct relationship

	PPC	BL	BE	CE	SB	ABE	PV	BI	HP	PQ
PPC	**0.736**									
BL	0.173	**0.854**								
BE	0.293	0.132	**0.820**							
CE	0.178	0.523	0.118	**0.801**						
SB	0.243	0.097	0.305	0.156	**0.775**					
ABE	0.193	0.126	0.232	0.144	0.188	**0.924**				
PV	0.190	0.154	0.224	0.350	0.226	0.120	**0.736**			
BI	0.116	0.225	0.128	0.161	0.465	0.137	0.201	**0.817**		
HP	0.148	0.168	0.248	0.226	0.261	0.155	0.235	0.248	**0.751**	
PQ	0.336	0.137	0.347	0.299	0.350	0.241	0.275	0.428	0.465	**0.724**

Source Authors' Calculations

Table 3 SEM result

	Structural Relationship			Std. Regression Weights	Regression Weights	S.E	T-Value	P-Value	Result
H1	ABE	→	BL	0.178	0.192	0.054	3.578	***	Accepted
H2	BI	→	BL	0.199	0.140	0.033	4.175	***	Accepted
H3	HP	→	BL	0.146	0.145	0.049	2.942	0.003	Accepted
H4	SB	→	BL	0.246	0.244	0.050	4.855	***	Accepted
H5	PQ	→	BL	0.107	0.122	0.057	2.134	0.033	Accepted
H6	PV	→	BL	0.100	0.099	0.048	2.043	0.041	Accepted
H7	PPC	→	BL	-0.054	-0.053	0.047	-1.132	0.258	Rejected
H8	BL	→	CE	0.211	0.217	0.060	3.584	***	Accepted
H9	BL	→	BE	0.279	0.302	0.055	5.469	***	Accepted
H10	CE	→	BE	0.288	0.264	0.053	4.941	***	Accepted

Source Authors' Calculations

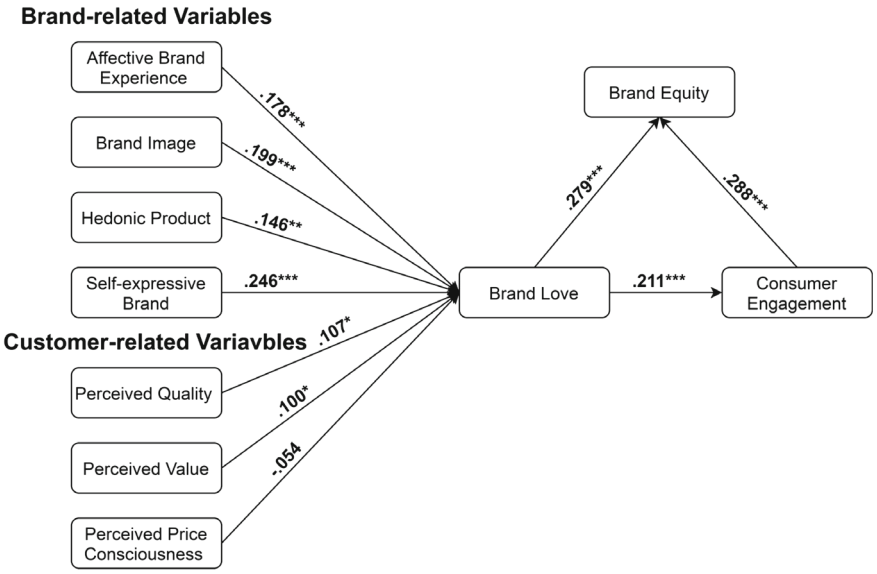

Fig. 2 SEM result

Discussion and Conclusion

Brand experts have come to recognise the critical importance of customers' ability to express their unique identities through their interactions with the products they purchase. A good emotional attachment is formed between consumers and a brand

when they feel that the brand accurately reflects who they are and what they stand for in society. Consistent with prior research by authors like Wallace et al. (2017) and Park (2015), our finding of a self-expressive brand supports the existence of such a phenomenon. As a result of the brand's excellent customer service, consumers have grown fond of the company. Previous investigations, including those by Unal and Aydn (2013), Anggraeni and Park (2015), Demmers and colleagues (2020), and Rahman and colleagues (2021), corroborate our findings on brand image.

The impact of an emotional connection to a brand on consumer loyalty was discussed next. Despite the relatively modest effect size, this is a crucial element in winning consumers on to the brand because it makes them feel something when they use it. Results from this study on emotional brand experience are consistent with those found in earlier studies by authors such as Park (2015), A-Qader et al. (2017), and Zhang (2019). In addition, the respondents reported that hedonic products had the smallest impact on the significance of developing emotional attachment for the brand. Though the result indicated extremely little influence, it is just as significant as other variables because it provides a wide range of entertaining options for clients, enhancing their sense of well-being and satisfaction. Other studies, such as Sarkar's (2014), de Oliveira Santini et al.'s (2020), and Khan and Kashif's (2023), also find hedonic products.

According to responses, customers give equal weight to a product's perceived quality and value when deciding whether or not to purchase it. It's crucial to remember the importance of making a good impression on clients. Perceived quality is consistent with prior research, such as that of Nguyen et al. (2014). The results of perceived worth are consistent with those of previous studies, such as Yang's (2010). Finally, the results for perceived price consciousness showed a negative and small effect on brand adoration. This result contradicts the work of Nguyen et al. (2014). One possible explanation is that customers who are price-conscious are willing to forego other considerations, such as quality and value, in exchange for a lower purchase price.

In addition, the data reveals that when customers show their appreciation for a brand, they are more likely to actively engage with the business by following its Facebook brand pages and other social media channels. They start following the company religiously, reading up on the business on its Facebook page and learning from other customers' reviews and comments. Other studies, such as Kang's (2015), Machado et al.'s (2019), and Rahman et al.'s (2021), support the impact of brand love on consumer involvement. In addition, the results suggest that customers who openly express their admiration for a brand are more likely to remain loyal to that company over time. Loyalty to a brand gives it an edge over rivals and increases consumer demand. Brand loyalty is positively correlated with brand equity, according to a number of studies (e.g., Machado et al., 2019; Palazon et al., 2019). The final part of the research analysed how fans' participation affected the value of the brands represented on Facebook. Customer engagement, as opposed to brand adoration, is profitable for businesses as it increases brand preference. It indicates that customers who often engage with brand-related content, such as user-generated content about their experiences with the brand, product reviews, and so on, are more loyal and

committed to the brand. This correlation's results have been supported by another research as well (Hollebeek & Macky, 2019; Machado et al., 2019; Wallace et al., 2022; Xu & Cheng, 2021).

Implications and Future Research Direction

The present study offers several implications for business practitioners in the present business scenario. Marketing managers must take into account both brand-related variables and customer-related variables while positioning a product or service before public for consumption. Consideration of these variables into the marketing strategy will definitely create high emotional bond between the consumer and brand which will eventually increase the perceived worth of a brand in and of itself. Further, marketing managers can also use brand love for engaging their existing customers on various social media platforms and also can attract new and prospective customers thereby. The present study acknowledges some limitations. The sample selection was limited only to student age between 18 and 30 years; hence the future research direction may be selection of both students as well as non-students for conducting the same study.

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A Systematic Literature Review on Fintech and Financial Inclusion in China

Palak Mittal and Ravi Inder Singh

Abstract Advancement in technology is leading to transformation in the socio-economic and political setup at the global level. The field of financial services has seen significant change in the last few decades due to ever increase in the use of technology here. The efficiency and extent of financial services have gone up, with technology playing an instrumental role in enabling access to financial services in remote areas. A paramount increase in the usage of financial services is seen by the unbanked and underbanked people recently due to technology making financial services reach the doorstep of this segment. The synergy brought in by the combination of technology and finance in the financial world in the new form of business organization called Fintech led to the emergence of this study. This study is a comprehensive systematic literature review from various databases like Scopus, Web of Science, IEEE, Sage Publications, and EBSCOhost. The research depicts that FinTech has improved financial inclusion in China by reducing the number of unbanked people. Thus, the government should enforce various regulatory reforms to promote fintech and remove complete financial exclusion from the country.

Keywords FinTech · SLR · Financial inclusion · Financial technology · Review

Introduction

> *"Silicon Valley is coming. There are hundreds of start-ups with a lot of brains and money working on various alternatives to traditional banking."* – Jamie Dimon

Over the past two decades, there have been widespread information technologies like the Internet in various commercial activities. This has also led to an increase in e-commerce activities across the world. The usage of e-commerce has various benefits like easy accessibility, a wide range of goods and services, and anytime usage. New business models that emerged in the wake of technology have created

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more efficient value chains, brought in innovative customer-friendly products and services, attracted new customers have significantly impacted agriculture, education, banking, and finance industry. The financial world is experiencing a very high level of quick changes in the products and services such as subprime mortgages, production processes (like credit scoring), services (Internet banking services), or innovation in the form of organizations (like incumbents banking), bringing the fundamental change in working of the banks, capital raising of the money by reducing the risk (Rajan & Lougi, 2001) and cost (Iqbal & Sami, 2017). Making banking reach unbanked and remote areas (Financial Inclusion), which seemed a herculean task earlier is made possible due to the technological development. Financial inclusion is the improvement in accessibility and equality in providing financial services such as savings, credit, risk management policies, etc. to a wide range of masses. Financial inclusion is significant for achieving the financial development of both developing and developed countries for reducing the inequality of income, poverty reduction, and overall economic growth of the country. Financial inclusion could be achieved through financial innovation like Artificial Intelligence, Machine Learning, the Internet of Things, Biometrics, etc. Moreover, Machine learning and Data analytics have widened the scope of the insurance and lending ecosystem, improving credit assessment and detection and prevention of frauds. The use of AI, IoT, and Information technology helped financial institutions in reaching the unbanked, underbanked segment and provides the gateway to the global digital economy (Demiriic-Kunt et. al., 1999) besides having just and equitable growth (Bisht & Mishra, 2016). Mobile banking and ATM are the major initiatives that would help in the reduction of the unbanked population (Bansal, 2014). Mobile phones will be accessed by around 107% at the global level, consistent with this, the World Bank stated that globally FI can rise using mobile phones. The World Bank Group reported that by 2020, one billion adult unbanked population will either have a transaction account or electronic media to store their money. Thus, FinTech would help in the matching unmatched demand and supply of financial services. The World Bank Global Findex Database reported that the number of individuals having accounts rose by 700 million with a decrease in the unbanked adult population by 20% from 2011 to 2014. FinTechs have commercialized themselves by promoting financial inclusion across the world and by promising to achieve the millennium goals of G20 nations through various FinTech business models like forex services, wealth management, crowdfunding, digital currency, and e-wallets (Mahalle et al., 2021). The World Bank Group (Mora, 2019) accounted that the unbanked population is huge in the poorest countries which is twice in comparison to rich countries, with 56% population being women. There was an improvement in financial inclusion, but still, 31% (1.7 billion) of adults are unbanked globally. In November 2018, the United Nations established a task force to evolve the strategies for financial technology promotion, advancing the SDG, considered a vital factor by the World Bank in reducing income inequality (Natile, 2020) and paving the way for economic growth (Sharma, 2016). In India, The RBI report (2020) focused on initiatives such as strengthening the payment ecosystem, and creating awareness, to ensure a better balance of the technology across the country. Jakhiya et al. (2020) stated that NPCI's,

Immediate Payment Services (IMPS) marked the onset of mobile payments in India will help the achievement of the financial inclusion and transformation of the entire nation of financial products/instruments/services.

There was an improvement in the Malmquist productivity cost by 6.26% by using financial technology in the banking sector of China. The share of China's mobile device transactions and the volume of third-party transactions have increased (Yao et al., 2018). Zhang et al. (2020) stated that financial technology has helped the financial industry of China in achieving regional equality by reducing urban–rural inequality, thereby, improving household income. China's digital financial inclusion is mainly promoted through its banking services rather than state-owned banks (Chen & Yuan, 2021). Leong et al. (2017) reported that digital technology has helped in improving financial inclusion by providing the strategic capability for increasing the market niche in financial sectors. It also helps in generating credit scores for non-traditional data in China.

The significance of Fintech in bringing the "unbanked" and "underbanked" population under the ambit of financial services in China has led to the emergence of the need for this study. Thus, this research paper caters to the objective of conducting a comprehensive systematic literature review on Fintech and financial inclusion in China. This study follows the systematic literature review technique following the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) for substantiating the research work in the field of fintech and financial inclusion specifically related to China. The research confirms the fact that financial technology has helped in achieving financial inclusion, reducing regional disparity, and contributing to the GDP of the country. This has also enabled us to achieve the Sustainable Development Goals in the long run.

Financial Inclusion

The process of ensuring the access to financial services and timely and adequate credit where needed by the vulnerable groups such as weaker sections and lower income groups at an affordable price is termed as financial inclusion. Financial inclusion refers to ensuring the access to appropriate financial products and services needed by every individual of the society in general and vulnerable institutional players. Financial inclusion plays a significant role in the economic development of the country, boosting its GDP. It refers to the inclusivity of the masses by improving the accessibility and usability of financial services among the unbanked people. However, financial inclusion cannot be achieved without financial literacy. This indicates that financial inclusion is the supply side of the financial services provided to the different sections in the society whereas financial literacy makes the demand by providing the knowledge to the people regarding the various services which they can demand. Thus, to achieve financial inclusion it is significant for the regulatory department to promote financial literacy among the masses, which will help in boosting financial inclusion. Financial inclusion cannot be developed due to the following barriers:

I. Regulatory constraints and limitations
II. Cultural considerations
III. Financial education and literacy
IV. Constantly developed technological breakouts.

The financial inclusion in China is above average across the globe focusing more on individual awareness and digital financial inclusion. Financial inclusion in China is manifested by using a higher amount of formal savings and formal accounts. The financial exclusion in China is voluntary in nature.

Financial Technology

Financial technology is also known as "FinTech". These technological startups cover a wide range of services like portfolio management, international money transfer, mobile payment solutions etc., that aim to challenge the traditional banking system. The users from both the banking services and investment in funds have been alluring to the FinTech, making these financial technologies as the future of banking and other financial services. Financial technologies have offered benefits in terms of lowering the costs and improving efficiency in the banking and financial services. There have been so many waves of technological innovations in the financial industry. With these technological innovations, the revolution in passive investing credit scoring and securitization has seen the urgency in the 1980s and 1990s respectively. Similarly, innovations in communications accounted for the use of ATMs in 1970, and mobile banking in the 1980s. This has brought the entry of information technology in the banking sector by the giants such as Tesco and Walmart in the UK during 1990. This has also led to the rise in the retail and electronic banking during the year 2000s. It was observed that the technological process has been a medium-term process, however, the external shocks like Covid-19 have amplified the adoption of financial innovations in the financial industry. Thus, the demand for the digital products and services has been strengthened and there is an increase in the penetration of the products and services in the markets.

However, the focus of China's Fintech industry is on the online investments, mobile payments, and online lending, unlike those of developed Western countries focusing on cross-border payments and cryptocurrencies. The major fintech development in China focuses on the financial inclusion facilitating the unprecedented access to the financial services. Moreover, the China's Fintech group players such as Baidu, Tencent, Ant Financial, and JD Digits possess the multiple licenses. Chen et al. (2018) stated that the financial technology has helped the China's economy in achieving the regional equality and boosted the economic growth of the country. Yao et al. (2018) opined that the technological innovations have helped in offsetting the benefits of the traditional financial services, promoting the Industrial Revolution.

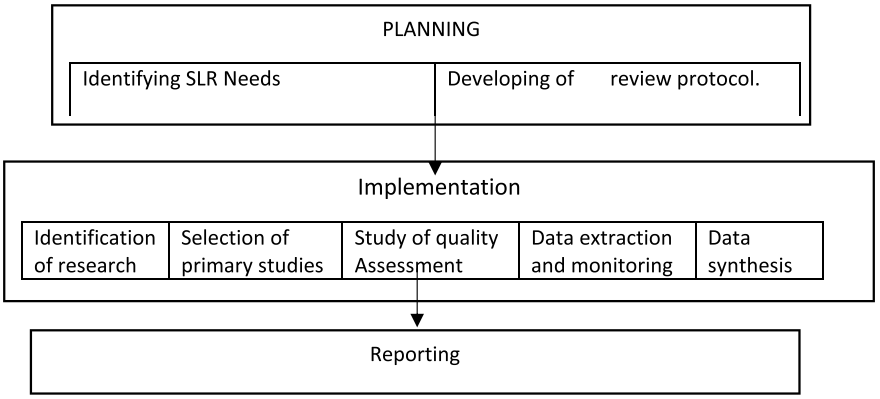

Fig. 1 Systematic literature review (SLR) methodology (*Source* Authors)

Research Methodology

In this study, a systematic literature review is undertaken to determine the types of study conducted to examine the relationship between Fintech and financial inclusion. This was followed by the reporting of the Preferred Reporting Items for Systematic Reviews and meta-analysis (PRISMA). The papers published during the period from 2004 to 2022 from the databases of Scopus, Web of Science, IEEE, EBSCO, and Sage publications were collected and reviewed for the comprehensive literature review. The systematic review methodology used in the study is depicted in Fig. 1.

Research Question

The research question of this study is **What is the relationship between fintech and financial inclusion in China?** we have conducted a comprehensive literature review. This review was conducted concerning China.

(1) ***Planning***: During the search strategy stage, the scientific production and various databases are analysed. The databases included IEEE, Sage Publications, Web of Science, and Scopus. The records obtained from WoS were 115 articles, from IEEE were 10 articles, EBSCOHOST business search revealed 48 articles, EBSCOHOST academic search revealed 52 articles, Sage publication gave 48 articles, and Scopus gave 160 articles. This accounted for a total of 433 articles. The research was conducted using the keywords "Fintech" and "Financial inclusion."

(2) ***Implementation***: We established specific criteria for inclusion and exclusion in order to avoid the possibility of subjective bias in selecting articles. Only articles that were published in English were considered for the study. The research

articles related to computer sciences and exact sciences were removed from this study, limiting only to business, economic, managerial, and social sciences. Thus, this study focuses on the conceptual understanding of the various research articles.

(3) ***Reporting***: After this, the selection of various research articles related to our research questions were selected and duplicate articles were removed from the study using the Mendeley software. For referencing and removing duplicate research articles, the Mendeley software was used. A total of research articles that were duplicated among all these databases amounted to 100 articles. However, 90 research articles were not available online. While a total of 168 articles had to be removed since they were not covered under the scope of the study. Out of the remaining articles, only 15 articles were accounted for the current study, focusing on China. To ensure that there is no selection bias, this review was carried out by three independent assessors, focusing on the quality assessment. In case of disagreement between these assessors, an independent assessor was consulted to reach the consensus. Thereafter, the theoretical knots among different studies were established. The focus of this research question was to ensure the credibility of the current research work.

The detailed process followed in the systematic literature review is shown in Fig. 2.

Review of Literature

Financial inclusion is one of the eight goals of the Sustainable Development Goals (SDGs). Financial inclusion helps in bringing the unbanked and underbanked people under the ambit of financial services that were earlier excluded out of the scope of banking and other financial services. Financial technology can help in promoting various sustainable development goals (SDGs) especially financial inclusion across the world. Fintech has opened various new opportunities and paved the way for achieving the financial inclusion across the country. This has led to the increase in the GDP growth rate across the country and also helped in achieving the Sustainable Development Goals (SDGs). Michael and Latkovska (2021) identified that the "Fintech dividend" contributes to around 3% to 13% of the funding for achieving the Sustainable Development Goals (SDGs). The researchers stated that around $150 billion- $200 billion of the Fintech investment would help in achieving the SDG activities. Arner et al. (2020) argued that digital financial inclusion can help in achieving the United Nations Sustainable Development Goals. They suggested four pillars for digital infrastructure development. The first pillar requires a simplified e-KYC system and opening of the bank accounts, and digital identity building. The second pillar requires well-developed electronic payment systems. The third pillar accounted for the usage of the pillars to support government regulations and provisions. Lastly, the fourth pillar requires the building and designing of financial systems and markets

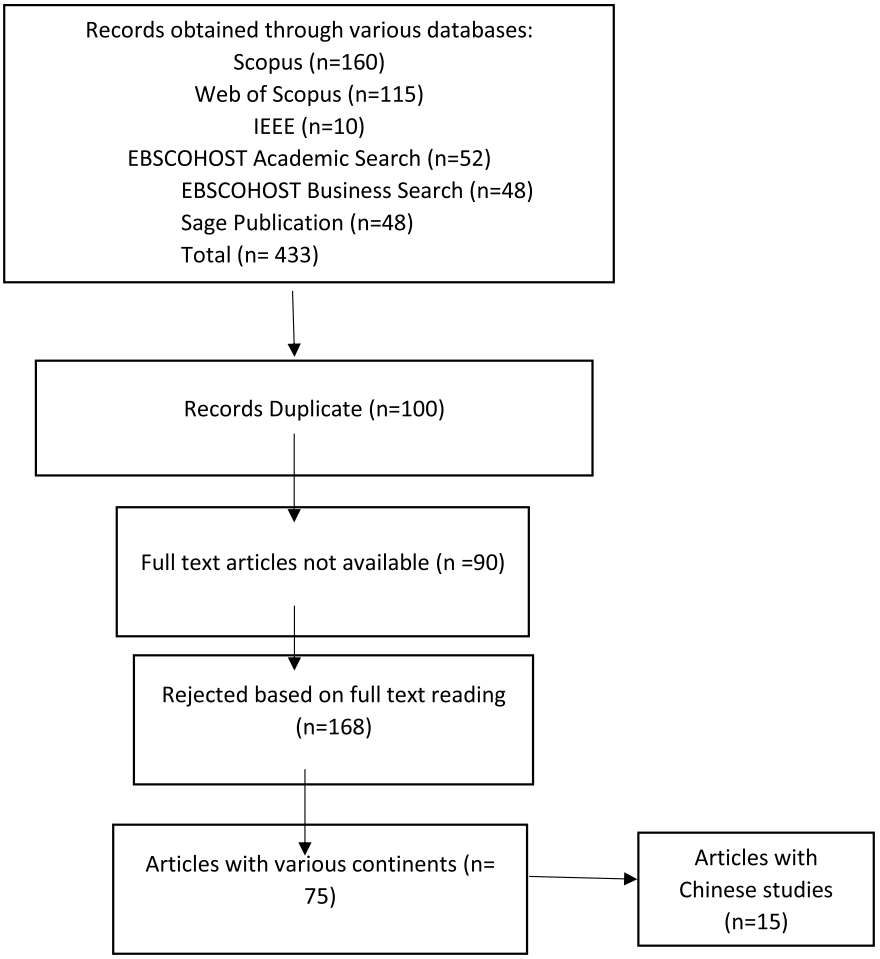

Fig. 2 Chart depicting PRISMA chart. *Source* MJ Page et al. (2020)

that would promote wider access to investment and finance. Kong and Loubere (2021) critically examined the financial models of JD and Alibaba, the two internet giants of rural China to contextualize by pushing the boundaries of digital financial inclusion worldwide. They found that their Fintech models have the potential to overcome the backdrop of Brick-and-mortar financial institutions. Hua and Huang (2021) determined the role of Fintech in transforming the financial landscape and overall economy of China. They identified 'stringent' and 'tolerant' support from the government for promoting financial inclusion, and supply-side shortage of financial services as the major drivers of the development Fintech industry of China. They stated that the Fintech industry has widened the readiness of financial services for low-income groups and small and medium enterprises. Zhang et al. (2020) found

that the Fintech rapid expansion has significantly enhanced the affordability and accessibility of financial services for the "unbanked" population in China. It was evident that the correlation between the fintech development and China's household income is positive. And there is a higher positive effect of financial technology on the rural development than urban development indicating that FinTech has lowered the urban–rural gap. Furthermore, the gain from FinTech is more for the poor than for rich people. Leong et al. (2017) conducted Delphi-method to obtain the data from the CEOs of the various companies for studying the case 'The fintech companies' development in providing micro-loans to college students; and reported that financial technology has helped in improving financial inclusion by providing the strategic capability for increasing the market niche in financial sectors. It also helps in generating credit scores for non-traditional data. Maskara et al. (2020) conducted research from borrowers' point of view to evaluate the role of Peer-to-Peer lending in improving the accessibility of financial services in the urban–rural dimension. The authors found that Peer-to-peer lending helps in improving the financial inclusion of rural communities lacking traditional financial institutions. P2P provides urban communities with an alternative to a few fringe banks. Yu and Shen (2019) examined the Peer-to-Peer lending regulations in China and concluded that rigid regulations on various lending platforms inhibit their capability as a broker, which in turn, harms the inclusivity and sharing of the economy's openness. Moreover, the researchers critically examined that limitless investment in P2P lending poses a threat to the inclusivity and leveraging of idle money. It was found that lending is influenced by trust, which will be significantly influenced by information integrity and the reputation of the borrowers. Trust is also affected by perceived information asymmetry, however, it does not directly impact the lending intention (Wang et al., 2015). Wirani and Ibrahim (2022) used an online questionnaire platform to analyze the responses of 104 respondents and found that the impact of familiarity, personal innovativeness, profit-sharing, trust, and security on the digital lending platform is significant. Yue et al. (2022) depicted that digital finance has contributed to financial inclusion but it has also created the financial distress. This study has used the city-level Digital financial inclusion index for 2013, 2015, and 2017, the China Household Finance Survey (CHFS) during the last four years in 2013, 2015, 2017 and 2019, and various other indices from Peking University digital financial inclusion index (DFI) of China. The study revealed that with the widening of digital finance, credit participation of households increases by impacting their marginal propensity to consume. Nevertheless, there is also a rise in the risk of financial distress due to the rise in borrowings. Luo et al. (2022) constructed the DEA super efficiency model to estimate the financial efficiency of 31 Chinese provinces. The researchers found that technological development contributes to the regional financial efficiency of China. This increases both the depth and breadth of digital finance leading to financial sustainability and financial inclusion. Guo et al. (2021) used the digital financial inclusion index and General Social Survey to examine the gap in Gender-wage gap and concluded that Fintech helps in the reduction of operating costs and capital constraints, by narrowing wage gaps between the genders by collecting the data from 16,844 respondents in China. Hasan et al. (2020a, 2020b) identified that

despite China's development, the disparity between the most and least developed regions of China using the secondary data and content analysis. This study pointed toward the critical issues and the regional disparity for inclusive development. Hasan et al. (2020a, 2020b) used the systematic review to analyse how the digital financial services have enhanced inclusive finance. The study revealed that inclusive finance can be achieved through DFS. The researchers reveal that rural population prefers the cashless transactions for their daily financial transactions enabling them to make the financial products and services make easily accessible and available.

The following Table 1 summarises the above study.

Results and Discussions

Financial exclusion is one of the major setbacks that hampers the growth of the country. This hindrance can be removed using FinTech in the financial services that would help to develop innovative financial services. This study is comprehensive to include most of the studies obtained from various databases. Digital financial inclusion can help in achieving the United Nations Sustainable Development Goals. The four pillars of digital infrastructure development are as follows. The first pillar requires a simplified e-KYC system and opening bank accounts, and digital identity building, the second pillar requires well-developed electronic payment systems. The third pillar accounted for the usage of the pillars to support government regulations and provisions. Lastly, the fourth pillar requires the building and designing of financial systems and markets that would promote wider access to investment and finance (Arner et al., 2020). The World Bank Group (Mora, 2019) accounted that the unbanked population is huge in the poorest countries which is twice in comparison to rich countries, with 56% population being women. They identified that there has been improvement in the financial inclusion, but still, 31% (1.7 billion) of the adults are unbanked globally. In November 2018, the United Nations established a task force to evolve the strategies for financial technology promotion, advancing the SDG, accounted as a vital factor by the World Bank in reducing the income inequality (Natile, 2020) and paving the way for economic growth (Sharma, 2016; Demirguc-Kunt & Levine, 1999).

Fintech's rapid expansion has significantly enhanced the affordability and reachability of financial services for the "unbanked" population in China. The correlation between the fintech development and China's household income is positive. Also, there is the higher positive effect of financial technology on the rural development than urban development indicating that FinTech has lowered the urban–rural gap. Furthermore, the gain from FinTech is more for the poor than for rich people. The studies reveal that fintech has impacted financial inclusion in China (Zhang et al., 2020). Stephen (2018) identified the LASIC principle (Low margin, asset-light, scalable, innovations, and compliance easy) for promoting FinTech in the key firms of the financial service industry. Despite China's development, the disparity between the most and least developed regions of China, there is the regional disparity for inclusive

Table 1 Summary of various research papers

S. no	Authors	Findings
1	Michael and Latkovska (2021)	The researchers stated that Fintech has provided various novel techniques to mobilize the resources. Around $150 billion- $200 billion of Fintech investment would help in achieving the SDG activities
2	Hasan et al. (2020a, 2020b)	The researchers reveal that the rural population prefers the cashless transactions for their daily financial transactions enabling them to make the financial products and services make easily accessible and available. This study confirms that inclusive finance can be achieved through DFS
3	Luo et al. (2022)	The researchers found that technological development contributes to the regional financial efficiency of China. Both the depth and breadth of electronic finance have risen by the technological growth in China. This has promoted the financial sustainability and financial inclusion
4	Guo et al. (2021)	The authors used the digital financial inclusion index and General Social Survey to examine the gap in Gender-wage gap and concluded that Fintech helps in the reduction of operating costs and capital constraints, with narrowing of wage gaps between the genders by collecting the data from 16,844 respondents in China
5	Yue et al. (2022)	The authors depicted that digital finance has promoted financial inclusion but it has also led to financial distress. The study revealed that with the widening of digital finance, credit participation of households increases by impacting their marginal propensity to consume. Nevertheless, there is also an increase in the risk of financial distress due to the rise in borrowings
6	Arner et al. (2020)	The authors argued that financial inclusion using Fintech can help in achieving the United Nations Sustainable Development Goals. They suggested four pillars for digital infrastructure development. The first pillar requires a simplified e-KYC system and opening bank accounts, and digital identity building, the second pillar requires well-developed electronic payment systems. The third pillar accounted for the usage of the pillars to support government regulations and provisions. Lastly, the fourth pillar requires the building and designing of financial systems and markets that would promote wider access to investment and finance
7	Kong and Loubere (2021)	The authors critically examined the financial models of JD and Alibaba, the two internet giants of rural China to contextualize by pushing the boundaries of digital financial inclusion worldwide. They found that their Fintech models have the potential to overcome the backdrop of Brick-and-mortar financial institutions

(continued)

Table 1 (continued)

S. no	Authors	Findings
8	Hua and Huang (2021)	The authors determined the impact of Fintech in transforming the financial landscape and overall economy of China. They identified 'stringent' and 'tolerant' support from the government for promoting financial inclusion, and supply-side shortage of financial services as the major drivers of the development of China's Fintech industry. They stated that the Fintech industry has widened the reach of financial services for low-income groups and small and medium enterprises
9	Leong et al. (2017)	The authors conducted a Delphi-method study and collected the data from the CEOs of the various companies for studying the case 'The fintech companies' development in providing micro-loans to college students and reported that financial technology has boosted the financial inclusion by providing the strategic capability for increasing the market niche in financial sectors. It also helps in generating credit scores for non-traditional data
10	Yu and Shen (2019)	The authors examined the Peer-to-Peer lending regulations in China and concluded that rigid regulations on various lending platforms inhibit their capability as a brokers, which in turn, harms the inclusivity and sharing of the economy's openness. Moreover, the researchers critically examined that limitless investment in P2P lending poses a threat to the inclusivity and leveraging of idle money
11	Wirani and Ibrahim (2022)	Using an online questionnaire platform to evaluate the responses of 104 respondents and depicted that the impact of familiarity, personal innovativeness, profit-sharing, trust, and security on the digital lending platform is significant
12	Wang et al. (2015)	The authors found that lending is influenced by trust, which will be significantly influenced by information integrity and the reputation of the borrowers. Trust is also affected by perceived information asymmetry; however, it does not directly impact the lending intention
13	Maskara et al. (2020)	The authors conducted research from borrowers' point of view to analyze the role of Peer-to-Peer lending in improving the financial inclusion of the urban–rural dimension. The authors found that Peer-to-peer lending helps in improving the financial inclusion of rural communities lacking traditional financial institutions. P2P provides urban communities with an alternative to a few fringe banks

(continued)

Table 1 (continued)

S. no	Authors	Findings
14	Hasan et al. (2020a, 2020b)	It was identified that despite China's development, the disparity between the most and least developed regions of China using the secondary data and content analysis. This study pointed toward the critical issues and the regional disparity for inclusive development
15	Zhang et al. (2020)	It was revealed that the Fintech rapid expansion has significantly enhanced the affordability and accessibility of financial services for the "unbanked" population in China. It was evident that there is a positive correlation between the Fintech development and China's household income. And the effect of financial technology on the rural development is higher than on urban development indicating that FinTech has lowered the urban–rural gap. Furthermore, the gain from FinTech is more for the poor than rich people

Source Compiled by authors

development. Hua and Huang (2021) determined how the Fintech is transforming the financial landscape and overall economy of China. They identified 'stringent' and 'tolerant' support from the government for promoting financial inclusion, and supply-side shortage of financial services as the major drivers of the development of China's Fintech industry. They stated that the Fintech industry has widened the reachability of financial services for low-income groups and small and medium enterprises. It was stated that the regulatory authorities should encourage the growth of technology like M-PESA as this technology serves the benefit of the economy. The other technologies that can boost financial inclusion are machine learning, artificial intelligence, blockchain technologies and many more. Therefore, the effective use of technology and financial literacy can act as the way for removing various knowledge, inaccessibility, and infrastructure problems of the unbanked and underbanked population.

It is suggested that there is a requirement for the regulatory authority to regularly monitor the high-interest rate, lack of transparency, and functioning of microfinance concerning the uneven credit marks. Arner et al. (2017) analysed that to bring financial stability & customer protection; The regulatory frameworks are also using the technology in the form of RegTech and are trying to redesign the financial system. Thus, the government's initiatives can help in enhancing the scope of financial products and services among the masses in China.

Conclusion

Financial inclusion (FI) is vital for the country to bring the unbanked people under the ambit of financial services. This will provide people with various opportunities for saving their income, providing more job opportunities, and enhancing their

income. This will also improve the marginal propensity of consumption among the people. Making banking reach unbanked and remote areas (Financial Inclusion), which seemed a herculean task earlier is made possible due to the technological development. Financial inclusion refers to the process of improving accessibility and equality in providing financial services such as savings, credit, risk management policies, etc. to a wide range of masses. Financial inclusion will help the overall growth of the economy and achieve the Sustainable Development Goals (SDGs). Financial technology is the use of technology information systems in the financial services sector. Financial technology will compete and complement with traditional financial service providers. Technology when used in the financial sector will provide various services to the masses that previously remained out of financial services. This study examines how financial technology has promoted the financial inclusion in China. The study reveals that the Fintech has proved to be significant in increasing the financial inclusion and promoting the regional equality and income equality. The major limitation of this study is that it is limited to only China. The limitation of the study is that due to the limitation of accessibility to the research papers, the study has limited research articles. Future researchers can conduct the study by including other countries to enhance the scope of the study. Moreover, the future research can include more keywords in their study to include a more comprehensive research study. This study will help the government, policymakers, and academic researchers to study various impediments and policies in China. The positive role of financial technology in promoting the financial inclusion can act as a motivator for various regulatory and government authorities to formulate the policies that will enhance the usage of financial technology in various sectors especially the financial sector so that "unbanked" and "underbanked" masses can be brought under the ambit of financial services providing them the services that were earlier unavailable due to limited access to the banking services. The regulators of financial services to engage themselves to re-align the existing supervisory and regulatory framework. By joint partnerships with the regulators can help in creating more robust and dynamic financial services. Moreover, the banks may collaborate with Fintech to achieve their operational efficiencies and better customer experience.

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Spreading of Digital Banking in India and Its Impact on Credit Risk During the Era of Covid-19

Sanjoy Laha and Rabin Mazumder

Abstract The paper highlighted on the impact of digital banking towards credit risk of the commercial banks in India. The digital banking parameters are represented by various financial ratios and the credit risk is represented by the net nonperforming asset to net advance ratio (NPA). Firstly paired t test has conducted to make a comparative view of understanding the influence of digital banking on financial indicators during pre and post Covid-19 era. To show the financial indicators those influenced the credit risk, proxied by NPA is represented by ordinary least square (OLS) regression analysis. But to get an unbiased result, Generalised methods of moments (GMM) analysis has been applied on the data set. Here credit deposit ratio (CRDEP), priority sector advances to total advances ratio (PRATT_ADV), ratio of term loans to total advances (TRMLN_ADV), ratio of secured advances to total advances (SECADT_ADV), ratio of interest income to total assets (II_TOTAST), cost of deposits (COD), cost of funds (COF), return on investments (ROINV), return on investments adjusted to cost of funds (ROINVADJTCOF) and capital adequacy ratio (CAR) are considered as independent variables and NPA as the dependent variable. The outcome of the analysis has shown that only TRMLN_ADV is negatively related with NPA. So, the research results show that the digital banking helps to mitigate credit risk by increasing loan disbursement. To control the credit risk especially NPA, the banking authority and government should take a firm initiative and set a proper regulation and monitoring so that people can be positively benefited by using digital technology.

Keywords Ordinary Least Square (OLS) Regression · Generalised method of moments · Credit deposit ratio · Cost of deposits · Cost of funds · NPA

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Introduction

The term "Digital Banking" refers to digital representation of traditional banking services to their customers. It means banking activities like enquiry of account balance, fund transfer in house or between two or more banks, updating the details regarding bank transactions, payment related to bills, applying loan and many more are performed through online or electronic platform. It eliminates the need of customers to visit physically to their bank branches. The banking activities are done by using internet access through smart phone, tablet or laptop in a secured way via password input or providing OTP. This approach benefits customers by making banking service available for 24×7 in anywhere with internet accessibility. Thus, digital banking transforms interaction of people towards availing financial services from traditional to digital mode in a secured way. Meanwhile the digital mode of operation of banks provides a secured way of completion of banking works within a stipulated time.

The concept of digital banking has gained attention in India in between late 1990s and early 2000s when banks offer basic online services like balance enquiry and fund transfer through electronic mode. But due to lack of knowledge, avoiding risk taking attitude and inertia towards accepting new technology has restricted the customers to utilise it. Later in the year 2010 real digital transformation has come into force with the advent of internet accessibility and widely usage of smart phones. At that time with emerging mobile apps, web browsers and banking software the banking operations become very much user friendly to their customers. In 2016 Unified Payments Interface (UPI) was launched which created a significant milestone; as it can be able to make seamless and instant transfer of fund from bank by using mobile apps. The Government of India took initiative to promote "Digital India" and "Jan Dhan Yojana" for spreading of banking in digital mode. Further demonetisation in 2016 has created a huge problem to customers for bulk transaction by using physical money as RBI has ceased the use of old denomination of Rs. 500 and Rs. 1000 notes. Again the long queue in banks to redeposit old Rs. 500 and Rs. 1000 notes has created a lot of harassment to common people. The situation compelled customers to transact money in digital mode.

During the 1st half of the year 2020, Covid-19 pandemic engulfed the world. During this phase people were compelled to use digital technology in banking services due to lockdown issue and for their safety. Reserve Bank of India (RBI) set up guidelines for digital transaction and security for bank's customers during the pandemic period. To inspire customers for digital transactions most of the banks offer limit free debit and credit card facility, mobile ATM, reward point consumption facility while using banking apps. "Know Your Customer" (KYC) norms set by RBI in digital platform allowing remote verification of customers through E-Adhaar or other verification modes.

Now-a-days the digital mode in banking operations and services has spread all over the world both in payment and lending domain. Thus, with increase in growth and increase in various systems and technologies the risk factors associated with it has

come to play. Though the spreading of Covid-19 has fueled the use of digital banking from the year 2020, it makes significant changes in banking economy. During Covid-19 phase, the values of NPA have increased. Banks suffer a lot by increasing NPA values, which ultimately reduce the value of return on asset (ROA) and thus jeopardise the profitability. Increasing nonperforming loan (NPL) may become responsible to reduce banking solvency that outbreaks financial crisis (Louzis et al., 2012; Reinhart & Rogoff, 2011). According to the statistical report of Reserve bank of India (RBI) the gross NPA to gross advance ratio was 2.35% in the year 2011. But the ratio has increased to 7.33% during the year 2021. Again, the ROA ratio was 1.08 in the financial year 2011–12. But the ratio decreased to 0.91 in the financial year 2021–22.[1] By considering the scenario the article focuses on the impact of digital finance towards credit risk. The study has set up two specific objectives:

1. To focus on a comparative view on impact of digital banking on financial indicators during pre and post Covid-19 period.
2. Identifying the factors responsible for mitigating credit risk which is proxied with NPA of banks in India in Covid-19 era while digital banking technology has flourished.

The entire research paper has been represented into a structured format. The research paper starts with a brief introduction followed by review of literature by different authors. The methods followed to conduct the research work is discussed next and then results and discussions are shown. The paper ends with conclusions and suggestions drawn from the analysis of results and references from various sources for presenting the paper are shown next.

Review of Literature

Researchers of different countries have demonstrated their ideas to illustrate the impact of digital banking on credit risk during the era of Covid-19. Zhao et al. (2016) applied the KMV model to execute how electronic banking influenced the credit risk of commercial banks in China. The authors concluded that the KMV model was well fitted to determine the credit risks of banks. With multiple times use of electronic banking, the credit risks had increased. Further the authors proposed that as the credit risks of banks under different systems had unique characteristics, a clear supervision and monitoring system must be followed to mitigate credit risks. The analysis on Bhasin and Gulati (2021) have shown that Banks, Fintech companies and even Government have made infrastructural changes that helped to control over the quick problems generated by the pandemic and timely manage the damage. According to Firdaus and Tobin (2022), digital banking provided good results in evaluation in planning and implementation of risk management technique than conventional services of

[1] Collected from Reserve Bank of India (2022), Statistical Table Relating to Banks in India, www.Rbi.org.in/scripts/annulpublication.asp.

commercial banking in Indonesia. Changes of technology and digitalisation attacked more customers for banking services and that accelerates better risk management. Kost (2022) has depicted that the consequence of digital risk comes from digital transformation, that creates obstruction towards achievement of company's business goals. Haralayya (2021) argued that with diminishing margins on deposits, rising competition, and evolving consumer mindset, digitalisation becomes necessary for businesses and banks equally. The study of Metawa et al. (2023) showed that there existed a direct and indirect impact of digitalisation and financial inclusion on credit risk of National Bank of Egypt. The authors concluded that by using portable money and banking service activities, the variables used for financial inclusion could be built. Kaur et al. (2021) carried out a structured survey by using Structural Equation Modeling (SERVQUAL) on northern Indian banking customers to know their satisfaction level by using digital banking. The result of the survey responded that the customers are highly satisfied by using digital banking. Further, the 'reliability' indicator has made a strong impact towards customer satisfaction which can be represented by 'tangibility' and 'responsiveness' indicators. Idawati and Syafputri (2022) have analysed the impact of various risk factors on the stability of banks. In the study the authors have selected four parameters like digital banking, credit risk, overhead cost and non-interest income. The banks that are listed on Indonesia Stock Exchange (IDX) are selected for the study. The study period is indicated as 2016 to 2019 as pre-Covid-19 phase and only 2020 i.e. Covid-19 pandemic phase. The analysis has shown that though the digital banking positively stimulates the banking stability, credit risk negatively influenced the stability of banks. Rest of the two indicators have no impact on the stability of banks on the two phases. According to Babarinde et al. (2020) the digital banking operation has created a new dimension to satisfy the customers who are well-known about of digital banking works. Yanenkova et al. (2021) applied value-at-risk (VaR) methodology for improvement of quality of risks associated with banks. The methodology is used for forecasting the indication of loan debts. Tharanikaran et al. (2017) has executed their research work by studying the customer's feedback towards use of electronic banking in Batticaloa district of Sri Lanka. The researchers found a high level of appreciation for service quality and customer satisfaction. The research work of Daoud and Kammoun (2020) have found that more banks will be encouraged to take more risks with the use of overhead costs, as greater the bank's expertise in controlling its risks and the overhead costs have a negative influence on the bank's stability. Bahillo et al. (2016) argued that digital transformation gives more transparency to risk reports. By strongly controlling the risk, banks can update their operations and customer assistance without damaging the risk concentrations, and additional efficient supervision for current portfolios. Westall (2022) has announced that the downgrade for the first time of Moody's Investors Service reduced its outlook to negative. In that perspective, Moody's explained that the increasing disadvantage risks to the sovereign's outside shock absorption capability considering an important reduction in the foreign exchange reserve cushion to confront future outside debt facility payments. Cheng et al. (2020) expressed that the quick spread of new corona viruses all through China and the world in 2019–2020 has greatly affected China's monetary and social improvement. Ozili's research (2018)

found that the digital financial operation has a positive impact towards stability on financial organisations. This is because it can develop financial inclusion and have lower financing.

So, the forgoing literatures presented by several authors have highlighted mainly two novel aspects, namely the issues related to the pandemic situation and interventions by the government. The impact of spreading of corona viruses and the interventions of policies on the NPA ratio in Indian banks has received little attention in those literatures. Banna and Alam (2021) revealed that the application of digital finance has a positive influence on banking stability and the financial system. The uncertainty of risk in banks becomes controlled and financial mobility increased. The results of Matey's research (2021) support My's (2020) research by finding that credit risk is inversely related to bank stability.

Previously researcher used to explain the information regarding increasing NPAs prior to the global crisis in financial areas and little attention paid to the facts concerning NPA behaviour across Indian banks pre and during the COVID-19 period. The determinants influencing on NPA of scheduled commercial banks in India during the era of Covid-19, when digital banking was the only mode of banking activities remain unsolved. In this backdrop the present research study has made a significant analysis on the influence of digital banking towards the factors those are considered as regulators of NPA of the commercial banks in India in the era of Covid-19. Further the study has identified the factors responsible for growing NPA in the commercial banks in India. Both of those two stated objectives are uniquely identified and never been discussed by any authors before. The study has made an exposure in front of new authors to expand their ideas in the area of analysis digital banking and credit risk on banks.

Research Methodology

The analysis is based on secondary data collected from RBI website, during the period from 2017 to 2022. The period of the study is considered to focus on how the digital banking influences on credit risk of the commercial banks in India during the era of COVID-19 pandemic. Here the pre Covid-19 era is considered from 2017 to 2019 and post Covid-19 era is considered from 2020 to 2022. To study ten numbers of Indian public and ten numbers of private commercial banks have selected which are shown in Table 1.

To understand the impact of digital banking on those financial indicators that control NPA and profitability of bank during pre and post pandemic period due to COVID-19, a paired t test has been applied. The paired t test determines the situation of credit risk, especially NPA of banks in India during pre and post Covid-19 scenario. Simultaneously the result also determines the applicability of digital banking technology to reduce continuously growing NPA, which is a burning problem in Indian economy.

The formula for paired t test is as follows:

Table 1 List of banks considered for the study

	Public sector banks		Private sector banks
1	Bank of Baroda	1	Axis Bank Limited
2	Bank of India	2	City Union Bank Limited
3	Bank of Maharashtra	3	DCB Bank Limited
4	Canara Bank	4	Federal Bank Ltd
5	Central Bank of India	5	HDFC Bank Ltd
6	Indian Bank	6	ICICI Bank Limited
7	Indian Overseas Bank	7	INDUSIND Bank Ltd
8	Punjab National Bank	8	Jammu & Kashmir Bank Ltd
9	UCO Bank	9	Karnataka bank Ltd
10	Union Bank of India	10	Kotak Mahindra Bank Ltd

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d)2-(\sum d)2}{n-1}}}$$

where d: difference per paired value of NPA before and after COVID-19 period

n: number of samples

Here,

Null Hypothesis H_0: No significance deference between the mean value of NPA before and after COVID-19 period.

Alternative Hypothesis H_1: Significant deference between the mean value of NPA before and after COVID-19 period.

The financial ratios are randomly selected based on the availability and continuity of data. The digital banking parameters are represented by selected financial ratios and the credit risk is represented by the net NPA ratio. Table 2 depicts the financial ratios with brief notation.

While considering the second objective of the study Ordinary Least Square (OLS) regression is used for the analysis of data. But to get an unbiased and fruitful result it is necessary to check the validity of the model. The regression analysis has shown that it contains multicollinearity, heteroskedasticity and autocorrelation issues. So, Generalised method of moments (GMM) is applied as a statistical tool to analyse the data.

GMM is a well-known statistical method which combines observed economic data with the information in population moments condition. It predicts the estimation of unknown parameters of the economic model. Using GMM approach, inference can easily be drawn by using its parameters. GMM can be seen as a very well tailored exactly to kind of information those are getting out from the economic model.

The model specification under GMM approach is:

Table 2 Financial ratios used for the analysis

Sl no	Variables	Abbr. as	Formula for calculation	Nature of variables
1	Net nonperforming Asset to net advances	NPA	Net NPA of the bank/ Net advances of the bank	Dependent
2	Credit deposit ratio	CRDEP	(Total Advances/Total Deposits) *100	Independent
3	Ratio of priority sector advances to total advances	PRATT_ADV	(Priority Sector Lending/Total Lending) *100	Independent
4	Ratio of term loans to total advances	TRMLN_ADV	100*(Term Loans)/ (Total Advances)	Independent
5	Ratio of secured advances to total advances	SECADT_ADV	(Advances secured by tangible assets + Advances covered by bank or Govt. guarantees)/Advances	Independent
6	Ratio of interest income to total assets	II_TOTAST	Interest earned/Total assets	Independent
7	Cost of deposits	COD	(Interest Expenses on deposits (P&L a/c)/ Average Deposits) × 100	Independent
8	Cost of fund	COF	100*(Borrowed amount x interest rate) x time period	Independent
9	Return on investments	ROINV	Interest earned on investments/ Investments	Independent
10	Return on investments adjusted to cost of funds	ROINVADJTCOF	Return on Investments—Cost of Funds	Independent
11	Capital adequacy ratio	CAR	Tier 1 Capital + Tier 2 Capital/Risk Weighted Assets	Independent

$$Y_{it} = \gamma Y_{i,\,t-1} + \beta X_{it} + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where, i = 1,2,…,8 and t = 1,2,..,6

Y_{it} is the net NPA to net advance ratio for ith bank,

α_i = the unobserved individual bank effect for the ith bank,

X_{it} = financial ratios of the banks for ith bank,

$\varepsilon_{i,t}$ = the idiosyncratic error term.

Expanding the indicators adopted in model (1) will give the following model:

$$\begin{aligned} NPA_{it} = &\alpha_i + \beta_1 CRDEP_{it} + \beta_2 PRATT\_ADV_{it} + \beta_3 TRMLN\_ADV_{it} \\ &+ \beta_4 SECADT\_ADV_{it} + \beta_5 ii\_totast_{it} + \beta_6 COD_{it} + \beta_7 COF_{it} \\ &+ \beta_8 ROINV_{it} + \beta_9 roinvadjtc_{it} + \beta_{10} cAR_{it} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

The hypotheses for the analysis are as follows:

(1) Null Hypothesis H_0: No significant impact of CRDEP towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of CRDEP towards mitigating credit risk during COVID-19 period.

(2) Null Hypothesis H_0: No significant impact of PRATT_ADV towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of PRATT_ADV towards mitigating credit risk during COVID-19 period.

(3) Null Hypothesis H_0: No significant impact of TRMLN_ADV towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of TRMLN_ADV towards mitigating credit risk during COVID-19 period.

(4) Null Hypothesis H_0: No significant impact of SECADT_ADV towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of SECADT_ADV towards mitigating credit risk during COVID-19 period.

(5) Null Hypothesis H_0: No significant impact of II_TOTAST towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of II_TOTAST towards mitigating credit risk during COVID-19 period.

(6) Null Hypothesis H_0: No significant impact of COD towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of COD towards mitigating credit risk during COVID-19 period.

(7) Null Hypothesis H_0: No significant impact of COF towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of COF towards mitigating credit risk during COVID-19 period.

(8) Null Hypothesis H_0: No significant impact of ROINV towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of ROINV towards mitigating credit risk during COVID-19 period.

(9) Null Hypothesis H_0: No significant impact of ROINVADJTC towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of ROINVADJTC towards mitigating credit risk during COVID-19 period.

(10) Null Hypothesis H_0: No significant impact of CAR towards mitigating credit risk during COVID-19 period.

Alternative Hypothesis H_1 : There exists a significant impact of CAR towards mitigating credit risk during COVID-19 period.

For the purpose of the analysis credit deposit ratio, ratio of the priority sector advance to total advance, ratio of term loans to total advances, ratio of secured advance to total advances, ratio of interest income total assets, cost of deposit, cost of funds, return on investments, return on investments adjusted to cost of funds and capital adequacy ratio are considered as independent variables and NPA as the dependent variable. The GMM analysis has conducted by considering no lag variable, lag(1 5) and lag(2 4).

Result and Discussion

To fulfill the first objective of the study i.e. impact of digital banking on credit risk, here proxied as NPA of scheduled commercial banks in India, a paired t test has conducted. But before conducting t test, it is necessary to check whether the sample has chosen for the analysis is normally distributed or not. For that purpose, Shapiro–Wilk test for normality test is performed. The results are shown in Table 3.

Both the dependent and independent variables used in the analysis are said to be normally distributed if the Shappiro–Wilk probability value is greater than 0.05 (i.e. at 5% confidence level the Shappiro–Wilk probability value > 0.05). The output of the analysis of Shappiro–Wilk test as shown in Table 3 revealed that all the probability values of the dependent and independent variables of pre- and post-Covid data are greater than 0.05 with 200 nos. of observations. Therefore it can be concluded that the pre and post- Covid data used in the model are normally distributed.

The output of Table 4 provides useful descriptive statistical result of paired t-test. While observing the columns of mean and standard deviation, it is seen that the values of pre Covid-19 are higher and the differences are 2.3235 and 2.7323 respectively. The difference in standard error value also shows 0.6109 with 95% confidence interval 1.045 to 3.602. The calculated t value is 3.803 with degrees of freedom is 19. The statistically significant (2-taied p value) of the paired t test

Table 3 Shapiro–Wilk test for checking normal distribution

Sl No	Variables	Pre-Covid data Prob	Post-Covid data Prob
1	NPA	0.09600	0.19260
2	CRDEP	0.07560	0.09934
3	PRATT_ADV	0.36477	0.09770
4	TRMLN_ADV	0.09062	0.26070
5	SECADT_ADV	0.07374	0.34600
6	II_TOTAST	0.45861	0.22100
7	COD	0.11223	0.71831
8	COF	0.28372	0.56217
9	ROINV	0.29590	0.35560
10	ROINVADJTCOF	0.31597	0.15900
11	CAR	0.08100	0.38585

(**Pr(|T| > |t|)**) under **Ha: mean(diff.) ! = 0** is 0.0012. As p value is less than 0.05 (i.e. $p < 0.05$), it can be concluded that the alternative hypothesis is accepted i.e. there is a statically significant difference between two variables. In other words, it can be said that the credit risk of the banks in India has affected by the appearance of Covid-19.

The research work further focus on to identify the factors responsible to reduce NPA of scheduled commercial banks in India in the era of Covid-19, while digital banking has applied. Following Eq. (2), the impact of credit deposit ratio (CRDEP), priority sector advances to total advances ratio (PRATT_ADV), ratio of term loans to total advances (TRMLN_ADV), ratio of secured advances to total advances (SECADT_ADV), ratio of interest income to total assets (II_TOTAST), cost of deposits (COD), cost of funds (COF), return on investments (ROINV), return on investments adjusted to cost of funds (ROINVADJTCOF) and capital adequacy ratio (CAR) on net nonperforming asset to net advance (NPA) has tested by using ordinary leased square (OLS) regression method. The outcome of OLS regression has shown in Table 5. Here P—value of F-Statistic (0.0000) is less than 0.05, which clearly indicates that the model is good fit at 5% level of significance and it is a valid model.

Table 4 Paired t-test

Variable	Observations	Mean	Std. Err	Std. Dev	[95% Conf. Interval]	
precov~a	20	**5.081**	**0.8519692**	**3.810122**	**3.297808**	**6.864192**
postco~a	20	**2.7575**	**0.347914**	**1.555919**	**2.029308**	**3.485692**
Diff	20	**2.3235**	**0.6109593**	**2.732293**	**1.044748**	**3.602252**
Mean (diff.) = mean (**precovid19npa–postcovid19npa**) t = **3.8030**						
Ho: mean(diff.) = 0 Degrees of Freedom = 19						
Ha: mean(diff.) < 0 Ha: mean(diff.) ! = 0 Ha: mean(diff.) > 0						
Pr(T < t) = **0.9994** Pr(|T| > |t|) = **0.0012** Pr(T > t) = **0.0006**						

The R-square and Adjusted R-square values are 68.11% and 65.19% respectively. It implies that the variation caused in the dependent variable by the independent variables is also a good explanation for the selected banks as well as the whole scheduled commercial banks in India.

Further, it is seen from the OLS regression that out of 10 independent variables considered for the study, 4 nos. of variables i. e. ratio of term loans to total advances (abbr. as TRMLN_ADV, p value 0.010), ratio of interest income to total assets (abbr. as II_TOTAST, p value 0.000), cost of deposits (abbr. as COD, p value 0.006) and capital adequacy ratio (abbr. as CAR, p value 0.000) have influenced on NPA. It means that those independent variables have statistically significant (5% level of significance) impact on NPA. The negative coefficient values of those 4 nos. of independent variables indicate that those components are inversely related with NPA.

Now, before accepting the result of OLS regression, the test for identifying best fitted data used in the model was performed. For that purpose Breuch–Pagan test for heteroskedasticity, Durbin–Watson test for autocorrelation and multicollinearity test by determining variance inflating factor have performed for both pre and post Covid-19 period. Table 5 shows the test statistics and outcome of the analysis.

By reviewing the test statistics towards the presence of heteroskedasticity, autocorrelation and multicollinearity on the sample data as per Table 6, it can be seen that heteroskedasticity is not appearing on the pre Covid-19 data but it presents in post Covid-19 data. Again Breusch-Godfrey LM test for testing autocorrelation has

Table 5 Results of OLS regression analysis

Independent variables	Coefficients	Std. Err	t	P > |t |
CRDEP	0.0112515	0.0327543	0.34	0.732
PRATT_ADV	0.0500393	0.0287912	1.74	0.085
TRMLN_ADV	−0.0518086	0.0197387	−2.62	0.010
SECADT_ADV	−0.000197	0.0330823	−0.01	0.995
II_TOTAST	−2.105123	0.4402574	−4.78	0.000
COD	−4.779364	1.698927	−2.81	0.006
COF	2.935237	2.027306	1.45	0.151
ROINV	4.427567	2.45355	1.80	0.074
ROINVADJTCOF	−3.590193	2.487756	−1.44	0.152
CAR	−0.4607764	0.122855	−3.75	0.000
_CONS	11.19263	3.622111	3.09	0.003
Number of obs. = 120				
F(10, 109) = 23.29				
Prob > F = 0.0000				
R-squared = 0.6811				
Adj R-squared = 0.6519				
Root MSE = 1.9022				

shown that autocorrelation exist in pre Covid-19 data but not present in post Covid-19 data. Multicollinearity issue exists in both pre and post Covid-19 database.

Based on the study objective, the research analysis mainly focuses on identifying the financial indicators that are responsible for movement of NPA during the study period when digital banking became popularised. To get an unbiased result, two stages least square generalised method of moment (2SLS GMM) method, implemented by Arrelano and Bond, 1991, has been used. The selected data are analyzed by using lag operator with no lag, lag (1 5) and lag (2 4). The entire analysis has been summarized in Table 7.

Table 7 shows the comparative results of GMM analysis with no lag, lag (1 5) and lag (2 4). All the three types of analysis gave the output robust as the number of group > number of instrument. The result of analysis with no lag, lag (1 5) and lag (2 4) have shown the Sargan statistic Prob > chi2 = 0.000, Prob > chi2 = 0.000 and Prob > chi2 = 0.0556 respectively i.e. instruments as a group are not exogenous. So

Table 6 Checking validity of OLS regression model

Test Name	Pre Covid-19 period		Post Covid-19 period	
	Test statistics	Results & conclusion	Test statistics	Results & conclusion
Breuch–Pagan test for Heteroskedasticity	Ho: Constant variance Variables: fitted values of npa chi2(1) = 3.47 Prob > chi2 = 0.0625	Rejection of Ho and no presence of Heteroskedasticity	Ho: Constant variance Variables: fitted values of npa chi2(1) = 5.18 Prob > chi2 = 0.0228	Rejection of Ho and presence of Heteroskedasticity
Breusch-Godfrey LM test for autocorrelation	H0: no serial correlation chi2 = 5.407, df = 1 Prob. > Chi2 = 0.0201	Rejection of Ho and presence of autocorrelation	H0: no serial correlation chi2 = 3.139, df = 1 Prob. > Chi2 = 0.0765	Rejection of Ho and no presence of autocorrelation
Test of Multicollinearity	Estimation of VIF: Variable VIF COF 39.67 COD 37.13 II_TOTAST 27.72 ROINV 22.02 CRDEP 7.31 CAR 4.27 SECADT_ADV 3.32 ROINVADJTCOF 3.15 PRATT_ADV 2.56 TRMLN_ADV 1.92	All the VIF values are not less than 10. So, multicollinearity exists in the sample	Estimation of VIF: Variable VIF COF 52.04 COD 102.03 II_TOTAST 6.39 ROINV 53.85 CRDEP 7.22 CAR 4.52 SECADT_ADV 2.36 ROINVADJTCOF 76.98 PRATT_ADV 2.68 TRMLN_ADV 1.83	All the VIF values are not less than 10. So, multicollinearity exists in the sample

Table 7 GMM Model determination

Independent variables	No Lag			Lag (1 5)			Lag (2 4)		
	Group variable: id			Group variable: id			Group variable: id		
	Time variable: year			Time variable: year			Time variable: year		
	Number of obs = 100			Number of obs = 100			Number of obs = 100		
	Number of groups = 20			Number of groups = 20			Number of groups = 20		
	Number of instruments = 16			Number of instruments = 16			Number of instruments = 15		
	Wald chi2(10) = 2651.77			Wald chi2(7) = 2651.77			Wald chi2(7) = 1424.14		
	Prob > chi2 = 0.000			Prob > chi2 = 0.000			Prob > chi2 = 0.000		
	Coef	Z	P > |z|	Coef	Z	P > |z|	Coef	Z	P > |z|
LnNPA L1	0.841	3.74	0.000	0.841	3.74	0.000	0.486	2.78	0.005
lnCRDEP	−0.046	−0.09	0.932	−0.046	−0.09	0.932	−0.409	−0.77	0.442
lnPRATT_ADV	−0.065	−0.16	0.876	−0.065	−0.16	0.876	−0.012	−0.03	0.974
lnTRMLN_ADV	−0.391	−1.88	0.061	−0.391	−1.88	0.061	−0.534	−2.39	0.017
lnSECADT_ADV	0.677	1.12	0.262	0.677	1.12	0.262	1.023	1.53	0.126
lnII_TOTAST	−0.116	−0.08	0.937	−0.116	−0.08	0.937	−1.644	−1.14	0.254
lnCOD	−1.526	−0.98	0.329	−1.526	−0.98	0.329	−0.521	−0.41	0.680
lnCOF	0.842	1.01	0.313	0.842	1.01	0.313	0.276	0.40	0.691
lnROINV	1.888	1.02	0.309	1.888	1.02	0.309	2.580	1.92	0.055
lnROINVADJTCOF	−0.353	−1.04	0.298	−0.353	−1.04	0.298	−0.331	−1.25	0.212
lnCAR	−0.080	−0.11	0.910	−0.080	−0.11	0.910	−0.454	−0.78	0.435

(continued)

Table 7 (continued)

	Arellano-Bond test for AR(1) in first differences: z = −1.22 Pr > z = 0.222 Arellano-Bond test for AR(2) in first differences: z = −2.45 Pr > z = 0.014	Arellano-Bond test for AR(1) in first differences: z = −1.22 Pr > z = 0.222 Arellano-Bond test for AR(2) in first differences: z = −2.45 Pr > z = 0.014	Arellano-Bond test for AR(1) in first differences: z = −0.67 Pr > z = 0.503 Arellano-Bond test for AR(2) in first differences: z = −1.97 Pr > z = 0.049
	Sargan test of overid. restrictions: chi2(4) = 37.38 Prob > chi2 = 0.000 Hansen test of overid. restrictions: chi2(4) = 12.47 Prob > chi2 = 0.014	Sargan test of overid. restrictions: chi2(4) = 37.38 Prob > chi2 = 0.000 Hansen test of overid. restrictions: chi2(4) = 12.47 Prob > chi2 = 0.014	Sargan test of overid. restrictions: chi2(3) = 2.08 Prob > chi2 = 0.556 Hansen test of overid. restrictions: chi2(3) = 7.19 Prob > chi2 = 0.066

the analyses have fulfilled the criteria of Sargan statistic. Further the analysis with no lag and lag (1 5) have shown that the p values of all independent variables are greater than 0.05, which implies that no independent variables have significant impact on NPA at 5% level of significances. The analysis with lag (2 4) has shown that only TRMLN_ADV has the p values < 0.05. Again TRMLN_ADV is negatively related with NPA. Thus it indicates that NPA will be reduced with increasing TRMLN_ADV and vise versa.

Conclusion

The purpose of the current research work is to understand the impact of digital banking on the scheduled commercial banks in India towards mitigating credit risk during the pandemic period. To fulfill the study objectives ten Indian public banks and ten private sector banks were selected and the analysis was carried out over a period of 2017 to 2022. To understand the impact of digital banking on financial indicators a paired t test was conducted by dividing the study period into two phases. The years 2017 to 2019 is considered as the pre Covid-19 period and from 2020 to 2022 is considered as the post Covid-19 period. The outcome of the result has shown that the credit risk of the Indian public and private sector banks is affected during Covid-19 era. The results have indicated that the application of digital banking significantly influenced financial indicators in Indian banking sectors. So, it can be concluded that digital banking during the Covid-19 era improves the banking operations towards reducing credit risk.

The GMM analysis, as indicated in Table 7 proves to be used as a very useful statistical tool for identifying the financial indicator/s responsible to control credit risk. The analysis was done by selecting ten independent variables (as mentioned in Table 2) from RBI website during the period from 2017 to 2022. As the data used for analysis containing heteroskedasticity, autocorrelation and multicollinearity issues; the GMM is conducted by taking log values of the variables (As mentioned in Table 6). The result has shown that the p value of term loan to total advance is 0.017 ($p < 0.05$) in GMM analysis while using lag (2 4), which indicates the acceptance of alternative hypothesis i. e. there exists a significant impact of TRMLN_ADV towards mitigating credit risk during the COVID-19 period. Again the coefficient value is shown as − 0.391, which means total advance is inversely related with NPA. Statistically it can be elaborated that with 1 unit increase of term loan to total advance, the NPA will be decreased by 0.392 unit. So, to reduce NPA banks have to increase disbursement of loan to their customers. So, during the pandemic period banks have tried to ease disbursement of loan by digital channel and this ultimately leads towards maintaining credit risk.

Suggestion

To make a control on the credit risk of banks, bankers should encourage their customers to their banking operations in digital mode and impose restriction for cost incurred in funding operations. Banks should provide accurate and reliable timely information, updated accounts with error free transactions while providing digital banking service.

Finally, government of the country should play a role in assisting banks in increasing digital banking acceptance. To increase the acceptance rate towards digital banking and to combat the resistance level of customers, the government should lay down certain policies for controlling over digital crimes and establish proper and clear arrangements of remedy and/or compensation of wrong doing or grievances.

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Application of Artificial Intelligence Technology to the Sustainable Development of E-Commerce: A Systematic Literature Review

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Abstract Purpose: This research aimed to ascertain how artificial intelligence (**AI**) is revolutionizing electronic markets, the associated benefits, and ethical issues. **Design/Methodology/Approach**: The methodology used in this study was a systematic review design, including the review of numerous scholarly articles on AI in e-commerce. In five academic bibliometric databases such as Scopus, Research Gate, Sage, Harvard Business Review, and Google Scholar, the articles that would serve the purposes of this study were sought. Keywords such as e-commerce, AI, sustainability, and ethics were used to search the related databases. **Findings**: The results demonstrated that AI in e-commerce has so many benefits, such as automation, customization, and efficiency. Artificial intelligence algorithms, through intelligent assistance and recommendation engines, also recommend how to optimize resources. Moreover, AI encourages logistics improvement relative to customer satisfaction. In addition, it is equally important for AI to help achieve sustainability by increasing the efficiency of resource consumption and promoting the circular economy. However, concerns about the misuse of AI due to biased algorithms, violations of data privacy, or loss of jobs call for the responsible use of AI tools and constraints on their manipulation during the development processes. **Limitations**: The study focused on modern literature primarily and missed key findings in some previous research works. In addition, the choice of databases and search keywords restricted the scope of assessment. **Implications**: Further research opportunities include a comprehensive literature assessment, user experience, real-world experiences, and case studies

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on the application of these knowledge areas, as well as a closer inspection of ethical frameworks across each domain mentioned in this paper, along with further technical coverage on the creation and use of artificial intelligence. **Originality/Value**: Specifically, this research will provide a broader understanding of how AI affects businesses and consumers in e-commerce. The research identifies both the positive and negative aspects of AI, thus helping in the responsible creation and deployment of AI technologies, furthering a thriving e-commerce market from an ethical perspective.

Keywords Artificial intelligence · Chatbots · E-Commerce · Sustainability · Sustainable development · Technology

Introduction

Artificial intelligence (AI) technology has been on the increased growth path within the recent few years due to increased security breaches and privacy intrusions within many e-commerce enterprises. Such incidents have affected the way many businesses function in a great way. E-commerce advancements have resulted in significant development in terms of strategies, requirements, and application improvement (Arif & Haider, 2010). This paper provides insights about the challenges that AI has faced, especially in online marketplaces for individuals or communities. Its usage has risen and been adopted in various regions, making many ethical issues crop up, ranging from households to companies. Many studies have been made throughout the years on ethics, responsibility, openness, and AI decision-making programs. The emergence of e-markets has coincided with a general trend toward faster and more efficient business processes. Electronic markets are "interorganizational trading systems that seek to smooth out supply chain inefficiencies by facilitating buyer–supplier information exchange on products, services, prices, and transactions in an integrated and synchronous Internet-based environment," according to Johnson. It has revolutionized how businesses conduct operations and transactions worldwide (Lewis, 2018). In contrast to more conventional forms of commerce, buyers and sellers in an electronic marketplace never actually meet. Nevertheless, this aspect presents other challenges, including technology, privacy, trust, and the law (Syam & Sharma, 2018).

The primary objective of ethical AI research and development is the increase of acceptance in addition to confidence from the public. With AI growing in every business around the world, some effort has to be made to create a reliable system. The technicality that makes a machine imitate behaviors seemingly characteristic of a person, or known as AI, has received a great deal of attention because of the massive social influence. For this reason, AI is related to favorable and unfavorable consequences (Patil et al., 2023). One can associate it with independence, effectiveness, wonders, and promises.

Conversely, correlations are linked to technological dependence in humans, inertia, and obsolescence. Technologies enabled by AI present moral and ethical

dilemmas in areas such as cyber security, unemployment, and decision-making. These systems also create more problems (Zawacki-Richter et al., 2019). The primary purpose of ethical AI technology is to make AI more convincing and widely adopted. As AI evolves in every business worldwide, a reliable system must be developed. Much attention has been given to the tremendous impact of artificial intelligence on societal levels (Vishnu, 2024). AI has both positive and negative connotations.

On the one hand, there are connotations of independence, effectiveness, wonders, and promises. However, other correlations include technological dependence on humans, stagnation, and obsolescence. Technology facilitated by AI presents moral and ethical issues about cyber security, unemployment, decision-making, etc. These systems also raise other problems (Lari et al., 2022). To maintain human control over AI, it is crucial to understand its ethical standards and legal framework. Our goal in this work is to help create a safe and secure online business transaction environment. Suppose a nation is to continue growing and expanding sustainably. In that case, anti-poverty programs must be implemented with various social demands, including economic growth, health care, education, social security, and environmental protection (Thamik & Wu, 2022).

As COVID-19 has made its way into the world, it has wreaked havoc on economies and lives. The outbreak has shown the failures of the Paris Climate Agreement and the 2030 Agenda for Sustainable Development, serving as a unique wake-up call. The world can be redirected towards the Sustainable Development Goals (**SDG**) if bold initiatives take advantage of a crisis moment when traditional policies and societal norms are disrupted. Most of the research scholars posit that societies need to focus on the SDGs to be sustainable, inclusive, robust, and very resilient. Thus, in this new age of artificial intelligence, in various fields, technology has been identified as having capabilities that can easily be equal to and even go way beyond human intelligence. New technologies and skills such as computing tools in terms of capacity, processing speed, Internet access, and the accessibility of large volumes of data. AI-generated forces are driving change in a variety of areas, including communication, transportation, health, manufacturing, and finance (Garbuio & Lin, 2019). An increase from $16.06 billion in 2017 to a predicted $190.61 billion in 2025 is the market worth of artificial intelligence technology (Markets & Markets, 2024). Only two AI technologies that have had wide application and become mainstream are robots and digital personal assistants such as Apple's Siri and Amazon's Alexa.

On the other hand, AI's speed, efficiency, limitless memory, and ability for self-learning are potent tools for professionals and researchers alike. Google CEO Sundar Pichai has stated that humanity's top focus should be AI development. Its depth surpasses that of electricity or fire (Clifford, 2018).

The widespread use of AI has changed many facets of our lives, but most studies have focused on the problems that have emerged as a direct result of this change. The fundamental issues brought about by AI technology have caused many people to be concerned about the state of the electronic market going forward. Due to the many social, ethical, and behavioral issues it raises for individuals, businesses, and society, AI threatens the economy's long-term viability (Valavanidis, 2023). Thus, this study discusses ways businesses can be more socially responsible and address AI-related

ethical concerns by examining how consumer markets are currently constrained by economic, social, cultural, and behavioral limitations on AI-enabled goods and services. While many are in awe of AI's impressive capabilities, many are also concerned about the privacy and security concerns it poses. Sustainable development is an essential concept in the e-commerce industry (Bawack et al., 2022). There has been a stampede towards sustainable development practices among consumers and companies; hence, sustainability is considered a potent weapon for gaining an advantage in online markets and maintaining a competitive edge. The e-commerce sector is affected by sustainable development models in several ways, including socially, economically, and environmentally. On the other hand, a business can increase its output and effectiveness by taking steps toward sustainable online commerce growth and ensuring, at the same time, that all individual factors are balanced (Macchion et al., 2017).

AI systems will prioritize privacy and security in the next industrial revolution while seeking maximum ethics. Most of the past studies have focused on AI technology's possible advantages and economic efficiencies. All these previous studies did not feature the drawbacks of AI. The growth in AI will only be sustainable if concerns about the effects of AI on people's personal information, national security, and community are resolved. Taking note of this information gap, the present study determines how the concept of artificial intelligence affects behavioral, psychological, social, cultural, and ethical issues in electronic markets. This study uses a systematic review as its research strategy because it relies on thorough data and meticulous techniques, which make research more credible and eliminate biases (Bala & Verma, 2018). Researchers in the academic and professional domains might greatly benefit from conducting extensive literature reviews. This research adds to our knowledge of AI on two fronts: the consumer and business. This study examines AI's specific challenges through behavioral, psychological, and ethical considerations, focusing on how these issues impact human life. The second part of the research looks at the problems with privacy and security, legal issues, and the responsibility of using AI in online markets (Brengman & Karimov, 2012). All online marketplaces that facilitate purchasing and exchanging goods and services in exchange for identifiable user data are covered on this page. The importance of establishing regulations and standards for online markets to protect consumers should be borne out by businesses from this thorough examination of AI's social and behavioral impacts (Song et al., 2019).

The Advantages and Disadvantages of AI

When properly programmed, intelligent systems do not make the same mistakes humans do; thus, we may reduce the errors and increase the accuracy much more than before (Osten, 2023). Natural and artificial disasters can benefit from applying artificial intelligence facilitated by robotics. AI machines that can perform repetitive jobs continuously without becoming bored will eventually be able to replace humans. Beyond the advantages mentioned above, AI has a lot more to offer. Individuals

are increasingly considering how AI might enhance their e-commerce businesses' customer relationships and profitability (Hopkinson et al., 2018). Some drawbacks of artificial intelligence are also worth noting. Despite the high expense of intelligent system applications, AI makes people less productive by taking over much of the labor (Chessell, 2018). The decrease in human intervention could result in a rise in the unemployment rate. Further, there is no room for sentiment or creative thinking when we employ AI algorithms.

AI's Strengths and Weaknesses

There are two perspectives to consider when exploring artificial intelligence, as John Searle highlighted. He described them as complex and flexible AIs. Weak AI, or narrow AI, describes artificial intelligence with limited capabilities. Flexible AI uses advanced algorithms to solve specific problems or perform reasoning tasks that do not tap into the full range of human cognitive abilities. Flexible AI can be very excited about the potential outcomes of AI (Vanneschi et al., 2019). This includes the idea of robots mimicking intelligent behaviour to solve complex problems and tasks. Because a machine can mimic human intelligence, it has imperfect intelligence. Google Search, Alexa, and Siri are prime examples of inefficient AI (Lee & Kim, 2019). Vital artificial intelligence, a branch of machine learning, holds that computers can become human-like intelligent systems. Any system or computer with "advanced AI capabilities" shall be referred to as having the ability to reason independently and perform relevantly complicated tasks without human aid (Jarrahi, 2018). Artificial machines have a deep understanding of artificial intelligence, which helps make decisions independently and apply complicated algorithms to perform various tasks without involving human beings. It is asserted that a well-organized computer can replicate human perception and human reasoning and thinking. This type of AI is often depicted in science fiction films such as "Her," "The Terminator," "I-Robot," and "Wall-E" (Hermann, 2021).

Review of Literature

Abulibdeh et al. (2024), with a particular emphasis on user and operational perspectives in their study, investigated the elements influencing the sustainable development of mobile e-commerce. The filling of this theoretical lacuna by understanding the evolution of AI in mobile e-commerce through qualitative research contributes significant findings and lays a foundation for further research.

Pathan et al. (2023) stated that AI can enhance the experience in the circular economy of online commerce. They also highlighted using AI-based practices in product lifecycle management, including remanufacturing, recycling, and refurbishment. Their work validated that AI reduces waste and contributes to increased

resource productivity. These twin benefits are essential in helping the e-commerce industry transition to a circular economic model.

Bawack et al. (2022) conducted a comprehensive study on the impact of AI on the energy efficiency of data centers, specifically within the purview of e-commerce activities. The research emphasized the capability of AI to enhance energy consumption patterns and optimize cooling systems through real-time data analysis and the execution of adaptive control strategies. Based on their results, AI has the potential to dramatically reduce the amount of energy used and greenhouse gas emissions produced in data centres, therefore contributing to the overall sustainability of e-commerce infrastructure operations.

Thamik and Wu (2022) delved into the several facets of consumer markets where AI-enabled goods and services provide behavioral, cultural, ethical, social, and economic concerns. Some of the themes encapsulated within the scope of this research include product safety, the examination of biases inherent in AI, the concept of individual liberty, considerations of health, and unemployment. The research design adopted for the study is an all-inclusive systematic review. The study's findings underscore the paramount importance of corporate entities demonstrating social responsibility and guaranteeing the robustness and security of AI systems. This is essential to facilitate sustainable advancement and progress. It is evident from the findings that AI is associated with inevitable deleterious consequences; however, it is advocated that it should be harnessed to serve the broader objectives of humanity. Consequently, it is incumbent upon the stakeholders in e-commerce domains to institute a robust framework of rules and regulations to safeguard the integrity and reliability of these systems.

Song et al. (2019) examined in greater detail how AI could increase the development of more sustainable and innovative products within e-commerce. Their findings highlight the ability of AI algorithms to understand consumer feedback and detect trends in the market, enabling the creation of products that cater to environmentally conscious consumers and reduce their impact on the environment during their lifecycle. The results of research experiments show that AI enables businesses to create more eco-friendly products.

Masriadi et al. (2023) concluded that rapid advancements in AI have had far-reaching consequences for the e-commerce industry. As a result, human labor is now easier, faster, and less concerning than before. Here, we look at where AI stands in e-commerce, specifically at AI assistants, intelligent logistics, recommendation engines, visual search, warehouse automation, and optimal pricing. This research elaborates on the competence of AI in simplifying and optimizing e-commerce operations with sophisticated operational competencies. Chen et al. (2020) conducted a similar study on how AI influences customer experience and personalization in e-commerce. The authors argued that AI technologies, such as natural language processing and recommendation systems, will empower more personalized shopping experiences, culminating in greater customer satisfaction and loyalty. Moreover, the study discusses how these improvements can drive sustainable consumer behaviour by promoting more efficient product use and reducing returns.

Fang et al. (2023) analyzed the effect of AI on the decrease in waste in e-commerce packaging. They added that artificial intelligence could be used in packaging designs and material optimization for minimum waste and maximum recyclability. Also, according to them, the results indicate that applying such advanced technologies would drastically lower the challenging environmental issue of excessive waste creation, which is inherently part of the e-commerce industry.

Zhang et al. (2022) investigated how AI can optimize supply chain management across e-commerce websites. They argued that using AI-based predictive analytics and machine learning algorithms in e-commerce will yield better demand forecasts, optimize inventory management, and improve logistic efficiency, reducing waste and improving sustainability. The findings indicate a significant reduction in carbon emissions and associated costs, substantiated by concrete data from case studies.

Song et al. (2019) argued that rapid growth in scientific knowledge, technological capability, and social and economic factors is fueling a vast expansion of AI applications within all areas of our lives, including online shopping. AI has revamped the concept of e-commerce through its application and boosted its growth through exemplary results. The main aim of this paper is to explore the current state of AI in the e-commerce domain, focusing on intelligent logistics, digital assistants, recommendation algorithms, and dynamic pricing strategies. Moreover, we will refer to the concrete example of Baidu takeaway to shed more light on the impact of AI on the progress and development of online business activities.

Vanneschi et al. (2019) identified the importance of effective risk management in preventing payment failures, which is growing due to the ever-increasing volume of online purchases. Default of payment occurs when a customer fails to pay their invoice within ninety days of receiving it. Credit scoring (**CS**) is a standard method for determining a customer's propensity not to pay. Numerous new advancements in several disciplines are being spurred by the AI revolution in online retail, particularly in computer science, engineering, and information science. Creating and overseeing the software and infrastructure that will drive these AI computations will increase employment in the IT sector, increasing e-commerce driven by AI. People with fewer transferable skills may worsen their job prospects due to AI and internet buying trends.

E-commerce's Potential for Long-Term Sustainability

The Role of AI Scientific and technological breakthroughs are changing how people work and live. In electronic marketing, AI technology has evolved into a potent platform to improve market growth and streamline e-commerce operations. Following this, one can get a presentation of several methods, such as an AI assistant (chatbot), a recommendation engine, and optimal pricing (Song et al., 2019; De Bruyn et al., 2020; Kaur et al., 2022).

AI Assistant (Chatbot)

Providing excellent customer service has become crucial to any successful company's growth strategy (Markey & Merkel, 2014). While contemporary companies can process payments more rapidly, they cannot provide 24/7 customer assistance. To automatically reply to basic voice commands, offer product recommendations, and meet the demands of consumers, an AI assistant (chatbot) primarily uses a natural language processing device (Huang & Rust, 2018). Chatbots on e-commerce and mobile websites utilize machine-learning algorithms programmed to reply to each user based on their preferences and actions. Users can use chatbots to find what they are looking for, see if it is in stock, compare prices, and make their purchase. Furthermore, the chatbot can connect consumers with questions or issues to the relevant support teams. Businesses are looking to AI to help them provide proactive customer care across several channels without needing a human agent to answer consumer problems (Kietzmann et al., 2018).

Automatic Recommendation System

The application of AI in the e-commerce domain opens up possibilities for immersive and personalized shopping experiences. Businesses may use AI-powered systems to track consumer needs in real-time and provide trustworthy, personalized purchasing experiences. Machine learning will analyze user needs and preferences to provide personalized product recommendations (Davenport & Ronanki, 2018; Zhang et al., 2022). AI could help understand consumer behavior by personalizing and analyzing clicks, shopping carts, purchase histories, and search inquiries. With the help of all these characteristics, online stores can suggest appropriate extra purchases to customers in a way that makes sense to them. Machine learning algorithms constitute the backbone of recommendation engines, which are all-inclusive recommendation systems (Lee & Shin, 2020). Algorithms powered by AI can handle various activities, such as mathematical programming, deep learning, consumer behavior modeling and interpretation, analysis of large data sets, and prediction of what will entice buyers. It starts when the recommendation engine's machine learning algorithm carefully captures the core features of a product based on the inferences obtained from the evaluation step. While doing so, it refers to the earlier search behaviors of probable users. After that, the recommendation engine generates relevant recommendations and duly displays them on the individual web page of the user for his consumption (Marjerison et al., 2022).

Optimal Pricing

Sustained price volatility over long periods impacts digital commerce—except for online retailers with deficient inventory levels. AI has considerably reduced the complexity of the automated pricing of thousands of products, as it can quickly process and analyze large amounts of data (Chen et al., 2020). To arrive at the ultimate comprehensive ranking, many things must be considered, such as product rating, logistics costs, and service quality (Mladenow et al., 2015). Determining the sweet spot for product or service pricing is challenging for merchants. This specific price challenge necessitates substantial investigation, which is where AI truly excels. With the help of AI, online retailers may build algorithms that can analyze data for price trends and make educated guesses about product prices. Analytics software is utilized to achieve this, which uses a mathematical model, deep learning, and various other AI models (Hagberg et al., 2016). Online retailers can save time and effort using AI-powered pricing solutions to keep tabs on their competitors' charges. This way, businesses could use data from inside and outside the company to set commodity pricing (Bawack et al., 2022).

Intelligent Logistics

The term "intelligent logistics" refers to a way of production in logistics that uses information technology to make robots and controls intelligent. This makes it possible for machines to take on the role of humans. When compared to traditional ways of handling logistics, intelligent logistics will significantly improve both the quality of customers' experiences and the efficiency of business operations.

The Automation of Warehouses

In online retail, AI is presently reshaping warehouse management for local companies. With AI-powered technology, pick-and-pack processes for goods that do not need lunch breaks can be automated. Robots powered by artificial intelligence can work around the clock daily (Agrawal et al., 2018). Advanced AI technologies, when implemented in a warehousing environment, likely reduce the frequency of errors to a minimal level. This is mainly because AI-powered machines can accurately detect their position and execute tasks based on predefined protocols, facilitating the movement and retrieval of items. Moreover, these robotic systems can be programmed with tasks that generally present a considerable risk to human workers, increasing safety within a warehouse (Carvalho et al., 2019).

Searching with Visuals

AI-powered visual search involves utilizing one image to search for other visual objects that share similarities or connections with the original image (Li et al., 2021). These visual search capabilities will undoubtedly resolve the problem of inaccurate reverse searches, as a single image may convey a wealth of information (Sipola et al., 2023). Customers often encounter complications while transitioning from the search phase to viewing a product while purchasing online, which usually leads to the cancellation of the transaction. Implementing AI in e-commerce has enhanced visual search functionality and aids in finding items that closely match the search query. Retailers have to give priority to the development of a smooth and convenient digital shopping environment in order to meet the needs of today's consumers. In this context, one of the critical ways that e-companies could guarantee satisfying their clients is to ensure adequate product catalog management (Frank, 2021). An electronic commerce catalog typically lists all goods indicated, the names of the products, the descriptions, prices, and details of the suppliers. The catalog should provide specific attributes like color, design, shape, cuff type, weight, and bottom type so that buyers get full and correct information about the products to be purchased. Proper catalog management is critical to preparation and assistance toward a perfect purchasing experience and making the right decisions.

Research Methodology

In the present study, five databases were used to conduct an exhaustive literature review: Scopus, Research Gate, Sage, Harvard Business Review, and Google Scholar were selected as these databases draw publications from different disciplines and provide recent literature (Song et al., 2019). Selective filtering was used, and only well-reputed journal articles were selected. The articles were searched manually using the following keywords: AI, e-commerce, sustainability, sustainable development, and chatbots. The search from all five databases ($n = 5$) yielded a total of 189 articles. In the next step, attention was only placed on articles published within the last five years from 2020 to 2024 to make sure that only the most current, relevant information with the most recent significant developments in the subject was incorporated, due to which 63 articles were removed and only 126 articles were screened in the next step. After screening on the basis of relevance, scope of study, and full-text availability again, 34 articles were dropped, and this led to a further reduction in the total number of articles to 92. The following filter of articles was done based on exclusion and inclusion criteria (Khan & Arif, 2023; Widjaja et al., 2023). Following the exclusion criteria, it was found that 54 articles did not align with the study objectives and, thus, were eliminated. In the end, only 38 articles (11 articles out of 18 articles from Scopus, 14 articles out of 24 articles from Research Gate, 3 articles out of 16 articles from Harvard Business Review, 6 articles out

of 16 articles from Sage, and 4 articles out of 18 articles from Google Scholar) were selected for in-depth analysis after the final filtering and screening. Finally, the selected publications' concepts, analytical approaches, and theories were analyzed, revealing common themes, patterns, and findings.

Here for systematic literature review, the study follows a protocol like the PRISMA approach to narrow down the number of articles from a large number of articles searching through five databases using key searching strategies (keywords) and following the steps of filtering and screening.

Figure 1 depicts an overview of this preliminary selection as the PRISMA flow, which serves as the framework for conducting a systematic literature review using PRISMA (Widjaja et al., 2023).

Data Analysis Technique

The content analysis method was used to analyze the gathered research data and identify regular themes and trends. A citation analysis of 38 articles was conducted, and it was found that the selected articles were cited 398 times. Thus, the average number of citations per article is 10.47. Furthermore, this study's analytical method maps out AI applications within sustainable e-commerce. All the information was then grouped under various significant aspects.

Publication Chronology

The timelines for publishing all the research articles were observed to track how artificial intelligence applications within sustainable e-commerce have evolved over the years, providing insight into trends and evolution within the field.

Source Evaluation

The origin of the research, which entailed journals related to AI, sustainability, or e-commerce, was checked accordingly. This assists in understanding the main ideas and forces that drive the knowledge available within the juncture of AI and sustainable e-commerce.

Sustainable Development Area

The studies have been carefully sorted out according to the specific sustainability goals they aim to further. That includes mitigating waste, improving logistical activities, and reducing carbon footprints. This methodological classification offers an

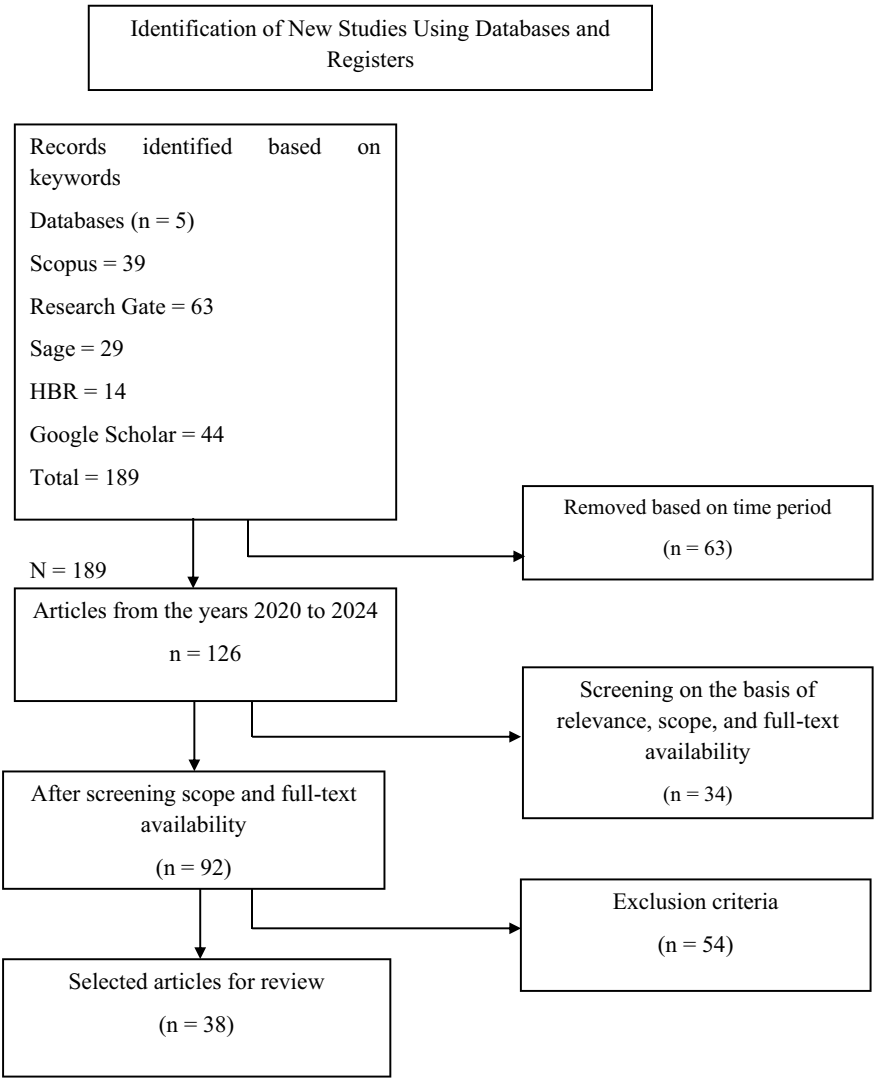

Fig. 1 PRISMA flow framework. Source: Authors' Compilation

overview and identifies the most prominent research within the scholarly discourse concerning sustainable e-commerce.

Findings of the Study

Through this thematic analysis method, researchers identified most of the major themes and patterns in the existing literature (Bawack et al., 2022; Song et al., 2019). This involved carefully extracting from each study the principal findings, arguments, and supporting evidence on AI and its influence within the e-commerce domain. The overriding objective was to construct a coherent framework for a comprehensive, clear, and understandable exploration of the complex multidimensional interplay between AI and digital marketplaces.

Significant findings indicate that AI is a game-changing element in e-commerce because of its sustainability and ethical benefits. In particular, some research **works** by Zhang et al. (2022) deduce that AI may be relevant in enhancing logistics management and performance optimization in data centers. It achieves this by reducing the waste generated and the aggregate energy consumed, thereby contributing to a more responsible e-commerce industry.

Moreover, Lee and Kim (2019) pointed out the severe role AI might play in establishing a circular economy by designing products that could be more efficiently recycled or refurbished. This insight is complemented by Fang et al. (2023), who pointed out that AI also significantly optimized packaging and reduced material usage. On the other hand, Chen et al. (2020) focused on the necessity of recommendation systems that enable sustainable consumption through the efficient use of products. However, losing jobs because of automation is a significant challenge, as explained by Vanneschi et al. (2019).

This concern is further compounded by the ethical issues related to biased algorithms and data privacy (Kaplan & Haenlein, 2019; Thamik & Wu, 2022). For AI to realize positive implications within the e-commerce sector, addressing such challenges requires a concentrated effort to formulate comprehensive regulatory frameworks. According to Thamikand and Wu (2022), such frameworks should aim to develop and deploy AI technologies responsibly. Dealing with these challenges will be the most essential basis for ensuring that the integration of AI into e-commerce brings out the desired results.

Discussion

The present study proposes a novel synthesis of the existing literature on AI and its impacts on e-commerce, including ethical and sustainable issues. The findings demonstrate the transforming ability of AI in packaging optimization, logistic enhancement, and innovation for a circular economy; at the same time, they present enormous challenges in job losses due to automation, ethics regarding biased algorithms, and data privacy.

This study is unique because of the comprehensive assessment. The study consolidates findings from different research to create a multi-dimensional view of artificial

intelligence's role in e-commerce. Through thematic analysis and systematic review, this study offers a broader understanding of the potential benefits and challenges associated with AI integration in e-commerce.

In the future, unbiased training datasets and more affordable AI integration solutions should be developed to enable the participation of small businesses. Research into consumer behavior and processes of building trust is also needed to understand how open data usage policies impact customers' willingness to adopt AI technologies and their perceptions of the environment. Longitudinal studies that inquired about the impact of AI-driven sustainability initiatives on environmental and business performance could bring new insights to a more ethical and knowledgeable application of AI in e-commerce.

Limitations of the Study and Future Research Opportunities

While AI holds a bright promise for a more sustainable future in e-commerce, several limitations must be accounted for. Major ethical concerns arise with the collection and use of data, specifically how bias in training data inhibits sustainability measures. This can lead to discriminatory results that are only available to some. Building AI into existing e-commerce structures implies enormous investments in technological development and particularly specialized knowledge, which at some point might turn into entry barriers even for small businesses. Therefore, building customer trust for such a system is of prime importance, and focusing on AI-driven sustainability efforts could be the best way forward. Consumers' environmental awareness level depends on the extent to which firms are willing to publish and thoroughly outline their data usage policy.

Therefore, future research on AI-driven sustainability in e-commerce should focus on several key issues, considering the limitations identified in the present study. To solve ethical concerns about getting and using data, scholars should first work on developing more diverse and unbiased training datasets. Research into detecting and eradicating bias in AI models will have more just and efficient policies on sustainability. Research in economical methods of AI integration may reduce entry barriers for small businesses and hence provide the spectrum of enterprises with more sustainable e-commerce. Further research might concern consumer behavior and processes for building trust. This applies explicitly to transparent data use policies, influencing customer acceptance of AI technologies and awareness of the environment. Longitudinal studies into the long-term effects of AI-driven initiatives on business performance and the environment provide valuable information that puts the application of AI in e-commerce on a more ethical and informed level.

Implications of the Study

However, the responsible application of AI can transform the sustainability landscape within the e-commerce sector. AI enhances logistical efficiency by analyzing massive datasets to project demand and designing delivery routes to minimize fuel use, reducing emissions. AI-driven prediction systems, therefore, can aid consumers in making wiser purchasing decisions inclined towards their preferences and reduce impulse buying, which is usually responsible for creating unnecessary packaging waste.

Contrary to that, AI has manifold functions in developing and optimizing a complete product lifecycle. AI can be used to support product diffusion and has a principal role in planning and executing various stages within this cycle. AI systems will be able to identify opportunities for integrating recycled materials and designing products that can be either reused or disassembled at the end of their service life. AI facilitates traceability and accountability by closely monitoring a product's lifecycle, from sourcing to final disposal. Moreover, being part of AI-driven technology, predictive analytics can predict how long a product will last before it stops working (Bongard, 2019). This proactive approach enables timely recommendations about maintenance or upgrades, thereby increasing the life cycle of a product and, hence, saving resources.

Recommendations

This study recommends a holistic approach to ensure that AI is judiciously used within e-commerce to foster a more sustainable future (Song et al., 2019). This is possible by first setting up a robust framework of regulations and standards to guide the development and operationalization of AI systems. This is critical in ensuring concerns about data privacy, security, and the viability of businesses (Thamik & Wu, 2022). Second, companies must emphasize the need for transparency in organizational activities. With the clear demystification of data collection and usage, an organization will be better placed to improve customer trust (Fang et al., 2023). Ultimately, the research highlights the importance of collaboration between researchers, policymakers, and industry leaders in fostering a coordinated effort to incorporate ethical considerations related to AI. By doing this, we can better utilize artificial intelligence's enormous potential to build a safe and sustainable online marketplace (Thamik & Wu, 2022). Finally, by identifying AI's benefits and drawbacks, all stakeholders can pave the way for responsible AI development and application and a thriving e-commerce ecosystem (Bawack et al., 2022).

Conclusion

The present paper is focused on how AI exerts multidimensional influences on e-commerce, covering various aspects of its advantages and limitations. According to the study, the different channels through which AI realizes operational efficiencies comprise intelligent digital assistants, complex recommendation engines, and optimally designed pricing systems. It also discusses ways of fostering innovation in logistic operations by automating the warehousing infrastructure and incorporating state-of-the-art visual search technologies.

The literature review identifies the positive role AI can play in improving customer experience and making better use of available resources to ensure sustainability within the e-commerce sector. However, it has also raised legitimate concerns concerning the possibility of biases in AI algorithms, risks related to breaches of security connected with data storage, and the ethical consequences of laying off workers upon implementing AI. These points underscore the requirement for a cautious and responsible pathway to developing and deploying AI technology. Detailed regulations and strict standards must be set up to ensure the responsible use of AI in e-commerce. The future lies in the hands of businesses, who must strike a balance between transparency and consumer trust and exploit AI's enormous potential for growth and innovation.

This is where the practical collaborative efforts of academia, government entities, and industry leaders would have to be ensured to address the associated ethical issues effectively and consequently retrieve the full potential of AI in pursuit of a vision for a sustainable and secure e-commerce future. This research makes a seminal contribution toward a holistic understanding of AI's multidimensional influence on consumers and commercial players within the digital marketplace. In this duality—positive contribution versus potential challenge—a path forward can be plotted for the judicious development and implementation of AI technologies, hence setting a foundation for a robust e-commerce environment able to thrive on responsibility and innovation.

DataAvailability **Declaration of Conflict of Interest** The authors have no conflicts of interest to report.

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Resurgence in the Manufacturing Sector

Modelling the Determinants to Develop a Sustainable Supply Chain in Taiwan's Semiconductor Manufacturing Industry

Parul Sinha and Karina Bhatia Kakkar

Abstract The semiconductor sector is essential to modern global markets, since semiconductor chips and components are indispensable for both commercial and consumer goods. In the last decade, the demand for semiconductors has surged due to the rapid integration of developing new technologies, including AI, fifth-generation wireless technology, and big data. This has expedited the digitization and automation of all industries. The company that produces the most semiconductor chips is the Taiwan Semiconductor Manufacturing Company (TSMC). The semiconductor sector in Taiwan necessitates supply chain sustainability and resilience for strategic objectives. The review thoroughly examined journal articles, book chapters, and magazines. This study identified determinants (DT) for making Taiwan's semiconductor supply chain a sustainable one. The research model was constructed via Interpretive Structural Modeling (ISM). It provides a systematic framework to understand and improve supply chain sustainability by demonstrating their interrelations. Environmental management, resource efficiency, innovative capability, regulatory compliance, and social stability are critical elements of success. The ISM-based model clarifies the hierarchical structure and relationships among these components. This study will aid industry stakeholders in identifying and executing sustainable projects.

Keywords Sustainable Supply Chain Management (SSCM) · Taiwan Semiconductor Manufacturing Company (TSMC) · Interpretive Structural Modelling (ISM)

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Introduction

Contemporary enterprises endeavor to enhance profitability, reduce expenditures, and integrate sustainability. Sustainability necessitates the equilibrium of economic gain, environmental conservation, and social accountability. The results indicate that organizations are prioritizing innovative sustainable supply chain management strategies and sustainability initiatives (Pagell & Shevchenko, 2014). A novel perspective on sustainable supply chains is required. Adhering to established standards and minimizing environmental impact are two methods to sustain supply chain management. Global warming, deforestation, ozone depletion, and pollution underscore the need of an environmentally sustainable supply chain. The analysis emphasized the critical success aspects of Taiwan's semiconductor supply chain for ongoing operations. Taiwan dominates global semiconductor production. Taiwan has the most advanced semiconductor chip technology (Brandenburg et al., 2014).

The digital economy is dependent on semiconductors. Support is provided for consumer and industrial gadgets and systems. The semiconductor manufacturing supply chain is mostly controlled by Taiwan. The global semiconductor shortage and rising geopolitical tensions have expedited TSMC's expansion. TSMC inaugurated the Taichung Newcomer Training Centre in 2021. This facility assists global corporations in their expansion efforts. To meet demand and sustain customer relations, TSMC is constructing additional facilities in Germany, Japan, and the United States. Facilities exist in Eastern China, Taiwan, and Washington State. Following the establishment of its first facility in Kumamoto, Japan, the company intends to construct two $40 billion microchip manufacturing facilities in Arizona and Phoenix. TSMC is constructing its first European fabrication facility in Dresden at a cost of $3.8 billion.

The semiconductor sector is grappling with increasing demand, especially for AI-driven systems. The challenges of globalization and complexity render sustaining the industry difficult. Sustainable supply chain management (SSCM) is increasingly important as organizations and governments reconcile economic growth with social and environmental accountability. TSMC must tackle social problems such as organizational procedures, environmental concerns including carbon emission footprint reduction, and economic challenges related to inventory management, transportation, and logistical expenses. Understanding analytical success criteria for sustainable operations is essential for achieving sustainability. The initiative seeks to emulate the success of Taiwan's semiconductor supply chain. The study offers a framework for industry stakeholders to implement sustainable initiatives using qualitative and quantitative approaches.

Review of Literature

The study of literature tackles contemporary issues. A systematic review produces context-specific knowledge (Tranfield et al., 2003). Tranfield developed Taiwan's semiconductor supply chain and sustainability database. Upon reviewing the literature, the authors recommended investigating the sustainability of Taiwan's semiconductor supply chain. The semiconductor sector is global and has the potential to enhance sustainability. Interpretive Structural Modeling delineates success elements and their interconnections. Manjunatheshwara and Vinodh (2017) assert that qualitative ISM elucidates conceptual and confusing models. Eric et al. (2024) recommended documenting the sustainability of the semiconductor supply chain. A comprehensive approach is required to comprehend the determinants of success and their interactions. Analyzing current compositions and research needs may be beneficial. Prior study illustrates conceptual significance. A comprehensive evaluation of prior research may alter the model.

The semiconductor sector has significant effect on society. Semiconductors are vital for electronics globally. They expedite technological and product development. The ecological ramifications of semiconductor supply chain management are vital to sustainability. Consequently, measures to mitigate global warming, deforestation, pollution, and ozone depletion are imperative. Taiwan, a worldwide economic powerhouse and technological leader, commanded 63.8% of the semiconductor industry in 2022. Taiwan dominates semiconductor technology and productivity, with the most sophisticated 2-nm process technology and accounting for over 70% of the global market for high-end integrated circuits manufactured with sub-7 nm technology. Taiwan dominates the semiconductor sector, accounting for 58.6% of integrated circuit packaging and testing production. Taiwan has the second position in the worldwide integrated circuit design manufacturing value market, accounting for 20.1%. Ministry of Economic Affairs, Taiwan (2022). The US-China trade and technology rivalry, together with the COVID-19 pandemic, jeopardizes Taiwan's centralized global semiconductor supply chain. In response to geopolitical concerns, several economies have relocated their semiconductor supply chains outside China to enhance security and resilience. The semiconductor sector must establish a sustainable and transparent supply chain to garner academic and practical interest. Consequently, more study is required to ascertain the elements and players influencing supply chain sustainability.

Montecchi et al. (2021) contend that categorizing and delineating the many sustainability-SCT connections is crucial for examining this emerging subject. The revelation and elucidation of sustainability-related information both inside and outside the supply chain is termed "sustainable supply chain transparency" (Schäfer, 2023). Gardner et al. (2019) characterize SSCT as sustainability commitments, initiatives, transparency, efficacy, and execution. Bai and Sarkis (2020) introduced three elements of SSCT: transparency, engagement, and product. Nevertheless, firms do not share information based on their interpretations and lack a comprehensive understanding of SSCT (Sodhi & Tang, 2019; Bai & Sarkis, 2022). Chen (2019) contend

that the conceptual underpinnings of SSCT need more examination in both theoretical and practical domains.

Iranmanesh et al. (2023) and Schäfer (2023) discovered that internal resources of enterprises propel competitive processes. SSCT delivers accurate supply chain data to assist firms in making more sustainable choices. The deployment of technology and enhancements in SSCT may augment organizations' trust and facilitate greater achievements. The social and environmental concerns inside the supply chain are complex, complicating sustainability efforts in the absence of supplier engagement. The study analyzed performance discrepancies independent of contextual influences. The analysis revealed substantial environmental disparities, enhancing supply chain efficiency. Research indicates that technological innovation is essential for productivity enhancement, with design being the foremost subsector of the semiconductor supply chain.

Tang et al. (2024) has done in-depth analysis of Taiwan's semiconductor sector, highlighting the need of supply chain openness for sustainability. The results indicate that six attributes and twenty indicators form a significant hierarchical framework. Information protocols and diagnostics, stakeholder efforts, and digital competencies are informal. The principal management components are manufacturing, warehousing, regulatory compliance, data security, safety, and data secrecy and connection. Enhancing environmental awareness throughout the industry's supply chain necessitates openness and traceability. Organizational protocols, resource optimization, cooperation, innovation, and technology contribute to the establishment of a sustainable supply chain.

Bui (2024) studies have not taken account of the economic and environmental issues influencing the sustainability of Taiwan's semiconductor business. According to Hao and Bu (2022) Taiwanese electronics industry, concentrating on TSMC and Foxconn. Within the supply chain, TSMC is characterized by resource intensity, while Foxconn is defined by labor intensity. Taiwan has capital-intensive and labor-intensive semiconductor supply chains. Transport models, organizational protocols, responsible packaging, resource optimization, inventory oversight, capacity management, supply chain expenses, sustainable purchasing, and waste management were examined. Economic issues were disregarded.

Lu and Hung (2010) analyzed the analytical factors of Taiwan's electronics industry's green supply chain management (GSCM) system in alignment with EU requirements. Four categories—life cycle management, supplier management, product recycling, and organizational engagement—were derived from twenty analytical attributes. Emphasis was placed on responsible packaging, resource optimization, cooperation, technology and innovation, inventory management, capacity oversight, sustainable sourcing, waste management, organizational processes, and transportation techniques. The study was conducted in 2010, a year in which Taiwan's corporate climate did not emphasize economic challenges. The following objectives were established after analyzing relevant literature and identifying deficiencies in previous research to direct the inquiry. The use of digital technologies in the

semiconductor sector can be used to make the supply chain sustainable. The correlations among these factors are analyzed. A detailed framework including these characteristics and their interconnections has been established.

Sacco and Magnani (2023) assert that researchers and institutions acknowledge the significance of multinational enterprises (MNEs) in achieving sustainable development goals. The extensive Sustainable Development Goals (SDGs) are national objectives, complicating their execution. This topic may facilitate international business research. The research situates extended value chain sustainability within the framework of international business literature. The examination of sustainability and resilience-building across global value chains is conducted. This study analyzes the semiconductor behemoth STMicroelectronics (ST).

Tao et al. (2024) evaluated Supply Chain (SC) performance in terms of economic, environmental, social factors, and resilience to supply and demand disruptions. As a result, supply chain network design must improve all performance metrics. Previous studies investigated these objectives individually or in a limited scope, neglecting their interconnection. The study consists of the four-objective MILP model for a multi-tier resilient and sustainable semiconductor supply chain network, including trade credit as well as supply and demand uncertainty. The model optimizes facility locations, supplier orders, economic production volumes, supply chain entity allocation, and supplier selection. The proposed supply chain network reduces carbon emissions and enhances the circular economy via carbon trading, recycling, and the disposal of end-of-life products. The fuzzy programming method tackles input ambiguities, whilst lexicographic optimization and ε-constraint govern the suggested model. This research demonstrates the model's applicability and offers managerial insights via a numerical example. Numerical analysis confidently produces Pareto optimal solutions for unknown parameters. South Carolina invests in reducing carbon emissions and generating employment opportunities. This research promotes sustainable and robust supply chain management while offering pertinent information to decision-makers.

In light of global carbon emission reduction and disruptions in supply chains, semiconductor supply networks must be resilient and sustainable. The UN's sustainable development goals and the target of achieving net-zero emissions by 2050 heighten environmental concerns. The UN emission gap research indicates that 140 countries have pledged to achieve net-zero emissions (UN Environment Programme, 2023). Numerous countries' carbon regulations mandate companies to reduce emissions and impose taxes on units. Corporate social responsibility, customer awareness, and expectations about a company's social contributions have made social sustainability a crucial element of supply chain network architecture. Nevertheless, the literature on supply chain network design has mostly overlooked this aspect. Global sourcing and outsourcing include intricate supply networks, rendering them more susceptible to disruptions. The globalization of chip manufacturing and sourcing complicates the semiconductor industry. This firm may be impacted by global supply chain disruptions.

Companies reliant on chips and the global economy are adversely affected by turmoil in the semiconductor sector. In 2011, the Japanese tsunami affected the

semiconductor supply chain. The COVID-19 pandemic lockdowns disrupted semiconductor supply chains, resulting in microchip shortages. The semiconductor chip deficit incurred a $110 billion loss for the automotive sector in 2021. The global microprocessor shortages underscore the need for resilient and sustainable supply chains. Consequently, semiconductor manufacturers and governments are contemplating capacity expansion to address the challenges. Taiwan Semiconductor Manufacturing Company (TSMC) is establishing fabrication facilities in Japan and the United States to augment capacity. TSMC obtained $6.6 billion in U.S. subsidies for its facilities in Arizona. An optimal supply chain network design influences facility investment decisions. The complicated multi-objective optimization issue in supply chain network design necessitates the reconciliation of opposing objectives to inform strategic and tactical choices, including supplier selection, facility location, allocation, and inventory levels, amid constraints and uncertainties. SC network design must include sustainability and resilience because of inevitable disruptions and increasing environmental and social issues, complicating formulation and solution processes. Multi-tier supply chains encounter reverse logistics networks, trade credit, and fluctuations in supply and demand. This indicates that conventional economic optimization is inadequate for resilient and sustainable supply chain network design.

Recent research by Tsao et al. (2024) characterized the design of a resilient and sustainable supply chain network as a multi-objective optimization challenge. This study emphasized economic and environmental sustainability above social factors and resilience. A deterministic MILP model establishes a sustainable supply chain network that lowers costs, minimizes greenhouse gas emissions, and generates employment opportunities. The research has overlooked social sustainability and has not optimized the triple bottom line. They regulate future flows using a certainty-driven single-objective optimization methodology. This mathematical approach enhances the construction of a resilient and sustainable supply chain network without using trade credit finance. Competitive supply chain networks must optimize sustainability, resilience, and efficiency. Current approaches are inadequate for constructing resilient, sustainable, and adaptable semiconductor supply chain networks. This project seeks to provide a mathematical model for resilient and sustainable semiconductor supply chain networks, including trade credit and uncertainties in supply and demand. The contributions to the study are as follows. It employs a fuzzy MILP model to establish a resilient and sustainable semiconductor supply chain network with four objectives: minimizing supply chain costs, CO_2 emissions, inventory dissatisfaction, and fostering job creation. The study analyzes global semiconductor and electronics supply chains, including both forward and reverse logistics networks. Third, it evaluates the uncertainties associated with supply and demand as well as trade credit finance. Managerial insights derive from quantitative representations and assessments of conflicting objectives. This study presents the first strong and sustainable supply chain network structure that integrates trade credit with supply–demand volatility.

Patidar et al. (2023) assert that supply chain resilience and sustainability are essential. The COVID-19 pandemic and geopolitical uncertainty have prompted companies and governments to prioritize supply chain resilience. The research

examines robust and sustainable supply chain network design. Certain scholars have identified antecedents of resilient sustainable supply chains (RSSC) for certain commodities. Integrate the predecessors of RSSC and demonstrate their significance and interconnections. Antecedents of RSSC derived from literature include visibility, flexibility, cooperation, control, circularity, digitalization, and network design. The fuzzy DEMATEL approach identifies the causal relationships among these seven antecedents. Multi-criteria decision-making evaluated and prioritized these antecedents. Researchers and practitioners may use the study's findings to evaluate the significance and interrelation of these factors inside their businesses, facilitating strategic and operational decisions aimed at mitigating supply chain interruptions.

Chaudhury et al. (2024) assert that the semiconductor industry is crucial to the global economy. The semiconductor industry provides IoT, AI, advanced manufacturing, and more technologies to the automotive, electrical and communication, healthcare, construction, and aerospace sectors. Procedural complexity, global supply chain integrations, regulatory frameworks, competitive pressures, technological obstacles, and more factors provide risks and challenges to the semiconductor supply chain. Limited research has investigated the risks, resiliency, and intricacies of green semiconductor supply chains. This study investigates the risks, resilience, and challenges associated with green supply chains in the semiconductor industry. TOE and DCV were used to develop a research model. The concept was validated by structural equation modeling including 356 semiconductor participants. This research indicates that technological turbulence, risk, compatibility, complexity, organizational dynamic capacities, resilience, and regulatory frameworks facilitate the semiconductor industry in adopting green supply chain management.

Xiong et al. (2024) said that geopolitical wars and public health crises had interrupted the semiconductor supply chain, resulting in a scarcity economy. This study integrates studies on semiconductor supply chain disruptions to evaluate vulnerabilities and resilience. The fundamental characteristics and challenges of the semiconductor supply chain are examined first. Geopolitical security and public health issues are tackled and alleviated. We advocate for more research to address deficiencies in the literature and highlight innovative supply chain management and decentralized networks for redundancy. We examine strategies to enhance the resilience and adaptability of the semiconductor supply chain to thrive in a rapidly evolving global environment.

Alizadeh Mousavi et al. (2022) said that complex supply networks need Advanced Planning Systems. In sophisticated planning systems, open architecture facilitates the incorporation of customized modules and algorithms for robust supply chain strategies. In intricate planning systems, anxiety and instability are unavoidable. This article models the Advanced Planning System (APS) and the material movement inside the supply chain. The SC APS underwent simulation testing. This case study analyzes the instability of a semiconductor's Advanced Planning System's Available-To-Promise (ATP).

According to Aldrighetti et al. (2021), a strategic choice in supply chain management (SCM) is supply chain network design (SCND). SCND evaluates disruption risk modeling. This study investigates quantitative models for Supply Chain Network

Design in relation to industrial logistics and disruptions in Supply Chain Management. This study examines the expenses associated with proactive robustness investments and parametric or structural modifications upon recovery. This review may assist researchers and decision-makers for several reasons. We first classify available information into decision-making difficulties to facilitate the correlation of SCND problems with network, supply, and demand modeling domains. Secondly, our methodology assesses disruption risk and the costs associated with resilience investments. Third, we examine the formulation of disruption probability and resilience costs. Fourth, SCND models analyze disruption risks and supply chain management factors (social impact, environmental effect, responsiveness, and risk aversion) within multi-objective modeling frameworks. Our ultimate deliverable is managerial insights. We notice deficiencies in the literature and suggest study subjects.

Supply chains encounter several unforeseen occurrences that interrupt operations and diminish performance, leading to reduced revenues, delivery delays, diminished market share and reputation, and decreased stock returns in today's volatile markets. Tang (2006) characterizes disruption risk as arising from natural calamities (such as earthquakes and floods) or anthropogenic actions (including war, terrorism, disease, pandemics, and strikes). Supply networks are seldom stable; hence, firms must prepare for unforeseen events to mitigate risks. Following the 2011 Japanese tsunami and earthquake, Toyota's suppliers depleted their inventory of components. This suspended Toyota production for many days. A disruptive event downstream in the supply chain may have a "ripple effect." The downstream operations of Ford and other automotive manufacturers were impeded by an explosion at Evonik's factory in Marl, Germany, in March 2012. The COVID-19 outbreak compelled some businesses to cease operations in China (CNBC, 2020). Ninety-four percent of Fortune 1000 companies have been adversely affected by pandemic-related supply chain disruptions (Fortune, 2020).

Clients from a compromised facility must be redirected to a viable alternative, resulting in elevated transportation and management expenses or potentially severe repercussions such as diminished customer satisfaction, distrust, pessimism, price inflation, and extended lead times. Unforeseen recovery costs in the supply chain are substantial; thus, the supply chain network must be designed to endure disruptions. Thorough literature assessment of quantitative Supply Chain Network Design models including disruption risk in industrial logistics and supply chain management. We evaluate the expenses associated with proactive robustness investments and revisions to disruption-risk parameters and structures. Our approach includes resilience and disruption costs, in contrast to previous studies. Both quantitative and qualitative studies examine SCND disruption and recovery. The authors are not aware of any studies regarding disruption risk and resilience investments in the optimization models of supply chain network architecture for industrial supply chain management and logistics. Quantitative techniques for resilient supply chains are extensively researched; nonetheless, the cost parameters of mathematical models differ by application. Consequently, the disruptive effects in the literature exhibit considerable variability. Consequently, decision-makers and researchers pursuing a resilience cost formulation model for supply chain network architecture in the

context of interruption risk may find our study advantageous. This study enhances and complements previous literature studies by concentrating on industrial applications and providing a thorough examination of the mathematical formulations of SCND under interruptions, without any overlaps.

According to Genc (2024), chips are essential to computers, telecommunications, healthcare, transportation, and energy systems. Life would be untenable without chips. This article examines semiconductor supply chain processes in both forward and reverse directions as a closed-loop system. The essay examines the processing and recycling of obsolete semiconductors to produce new silicon and chips, as well as the impact of a community subsidy framework on both upstream and downstream semiconductor businesses. The proposed semiconductor supply chain consists of a return mechanism that reacts to financial incentives, subsidy legislation that encourages end-user recycling, an upstream sector that produces silicon from both virgin and recycled materials, and a downstream sector where semiconductor manufacturers (TSMC, Samsung, Intel) procure silicon and other materials, utilize labor, and market chips. By determining Stackelberg equilibrium prices and outputs and confirming model parameters using empirical data, we analyze the impact of subsidies and collection channels on silicon and semiconductor manufacturers. No evidence exists to suggest that subsidies influence the strategic decisions of semiconductor companies. The circular economy advantages both the environment and the economy.

Shahid et al. (2024) advocate for companies to adopt sustainable methods to achieve global carbon neutrality by 2050. Artificial intelligence for digital transformation is attracting interest from academics and practitioners. The impact of digital transformation on carbon neutrality is being evaluated, particularly within the semiconductor industry. This study investigates the impact of artificial intelligence, digital transformation, and carbon neutrality on the enhancement of green supply chain performance. The research model was evaluated using partial least squares structural equation modeling, bootstrapping, and importance-performance map analysis. Four hundred twenty-six workers of a Chinese semiconductor business completed a standardized questionnaire. The results indicated that AI facilitates the digitization of Chinese semiconductor firms. The research indicated that digitally transformed organizations might achieve carbon neutrality more rapidly. The study demonstrated that carbon neutrality enhances the sustainable supply chains of semiconductor manufacturing companies. These results may assist logistics and supply chain management in comprehending how AI may enhance sustainable supply networks. Human-induced greenhouse gas (GHG) emissions contribute to global climate change. The primary climate goal of the UN is achieving carbon neutrality by 2050. Businesses are essential for achieving future decarbonization. Nevertheless, enterprises attempting to reduce carbon emissions often discover that their direct emissions are little in comparison to those generated by their intricate supply networks. Emissions from the supply chain are, on average, 20% more than global emissions. Businesses must involve suppliers and customers at several levels to achieve CN objectives. Currently, “semiconductor” denotes integrated circuits (computer chips), and the semiconductor industry propels the world economy. The industrial sector of China, particularly semiconductor manufacturing, has propelled economic development,

and the government's focus on CN has influenced semiconductor production. The government promotes regional industrial restructuring, research and development, and the advancement of green technologies to reduce carbon emissions.

Policies seek to promote sustainable ecosystems and reduce carbon emissions. Research indicates that China requires corporate implementation, industrial transformation, technological innovation, and regulatory support to achieve its objectives. This achievement demonstrates the semiconductor industry's dedication to CN, in contrast to its ambiguous low-carbon objective. Digital technologies such as AI may potentially save expenses and enhance service, coordination, productivity, and operational efficiency. Business strategy involves using AI technology to facilitate novel human–machine interactions and enhance organizational efficiency. Organizations use AI in manufacturing, design, and management. Upon receiving inputs, these rational AI systems execute tasks in accordance with their models and functionalities. In semiconductor manufacturing, AI identifies abnormalities, interprets photos, and engineers products. Deep learning and machine learning might assist in addressing challenges in semiconductor production. Global environmental awareness has led to an increased demand for low-carbon electronics, prompting the semiconductor industry to create carbon footprint assessment methodologies. Energy-efficient nano-imprint lithography (NIL) is under consideration for semiconductor CN. Artificial intelligence provides companies with more autonomy. These transformative changes compel authorities to reassess national commitments throughout the semiconductor supply chain. The primary rationale and distinguishing feature of this work is its empirical measurement, which has been overlooked by specialists. This article analyzes the use of AI by China's semiconductor industry to attain net zero carbon emissions for society. In the Fourth Industrial Revolution, also referred to as Industry 4.0, digital transformation may enable companies to achieve sustainable competitive advantages and surmount developmental constraints and technical challenges. The impact of digital transformation (DT) on technological innovation in China (CN) remains under investigation, with research using either a macro or micro perspective to analyze the effects of various digital technologies. This research gap necessitates a deeper comprehension of Digital Transformation (DT) and Change Navigation (CN), including stage and scenario dynamics. CN research examines policy and technology across global, regional, and national dimensions. While some studies examine the reasons corporations implement proactive environmental policies, there is little understanding of the semiconductor industry's dedication to corporate sustainability and its impact on green supply chain performance.

The study presented a scholarly discourse on digital transformation, circular economy, and green supply chain practices within China's semiconductor industry. This extensive study on the impact of AICs on the digital transformation of semiconductor enterprises addresses the deficiencies of previous studies that either lacked empirical metrics or concentrated only on macro-level perspectives. These findings indicate that semiconductor manufacturers might use AI to achieve CN goals and enhance GSCP. Digital transformation influences a company's competitive networking, and this research demonstrates the enduring impact of digital initiatives. The study investigates digital transformation initiatives and their impacts to provide

essential empirical evidence about the role of digital technology in promoting environmental sustainability. Consequently, stakeholders and regulators may accelerate digital transformation to achieve carbon neutrality objectives in the semiconductor business. The correlation between semiconductor firms' CN and GSCP was analyzed to address research gaps. The findings demonstrate the impact of CN on GSCP, illustrating the influence of sustainability requirements on supply chain management. The empirical result enhances our comprehension of CN's semiconductor business model and informs supply chain and logistics management in the strategic integration of AIC to elevate GSCP.

Mei et al. (2024) said that the semiconductor industry requires dependable Germanium (Ge) for electronics, fibre optic cables, and solar cells. The production of germanium is constrained by host minerals such as zinc and coal due to its association with these elements. The evolution of recycling networks and technologies complicates the recycling process. Ge shortages complicate the fulfilment of future demand. The Ge cycle metabolism of China from 2002 to 2021 is studied throughout its life cycle using dynamic material flow analysis. Ge demand in China increased from 19.16 tons in 2002 to 85.87 tons in 2021. Germanium was mostly used in infrared optical devices (36.76%) and fibre optic cables (54.59%). The 40-fold surge in GE stock utilization indicates recycling possibilities. Only 13.45 tons of germanium were extracted from end-of-life commodities, whereas 1,086.92 tons and 585.27 tons were sourced from coal ash and zinc concentrates, respectively. The loss of Ge during manufacture amounted to 1586.31 tons. General Electric's stockpile of intermediate products is decreasing. The total Ge export amounted to 655.64 tons, mostly consisting of intermediate components, but exports of finished products have increased. Based on these findings, many policy recommendations are proposed, including enhancing Ge production efficiency and supply sources, recycling Ge, and modernizing the Ge industrial chain. These laws might benefit the global semiconductor supply chain.

There is integration of literary analysis with analytical modelling to accomplish these objectives. The inquiry aims to enlighten industry leaders and aids in the establishment of sustainable policies and strategies for the semiconductor supply chain. The research highlights Taiwan's distinctive semiconductor sector and adds to debates on high-tech Sustainable Supply Chain Management (SSCM). The study's conclusions will facilitate enduring economic and environmental benefits in the semiconductor supply chain's shift towards sustainability and resilience.

As a result, the following 12 Determinants (DT) discovered in the literature study are shown in the Table 1.

Research Methodology

The determinants which effect the success of Taiwan Semiconductor industry have been drawn from the literature. 12 determinants were considered as important for the success. Hence, they are analysed by the experts and the relation between the determinants is explained by doing in depth analysis and discussions. The ISM model

Table 1 Determinants

Determinants	Representation	Explanation	Source
Carbon emission footprint	DT1	Measurement of the amount greenhouse gases emission from the product, enterprise, or country	Bhattacharya et al. (2024), Nassar et al. (2024), Oprica et al. (2024)
Organizational procedures	DT2	The response of the employees of the organisation	Bogataj and Bogataj (2007), Buffington et al. (2017)
Transport model	DT 3	The model that illustrates the relocation of objects from one site to another without any modification	Asha et al. (2022) Joltreau (2022), Murray-Tuite and Wolshon (2013)
Accountable packaging	DT 4	The packaging must be constructed from recyclable materials, designed with environmental considerations, and utilized judiciously	Baloch and Rashid (2022), Morahsti et al. (2022)
Optimization of resources	DT 5	Resources must be employed with maximum efficiency and effectiveness. The procedure involves identifying, prioritizing, and employing resources	Battini et al. (2014), Wu and Pagell (2011), Xiang et al. (2024)
Collaborative endeavor	DT 6	Collaboration among stakeholders that can augment the value of a product or process	Ortolani et al. (2011), Rubio-Andrés and Abril (2024)
Technology and innovation	DT 7	The latest technology that guarantees the system's long-term sustainability	Barros et al. (2018), Correa and Xavier (2013), Magherita (2023)
Capacity management	DT 8	Effectively distributing resources to enhance their utilization and optimize available capacity	Manzini and Accorsi (2013), Sharma et al. (2024)
Logistics expenditure	DT 9	The cost constitutes a fraction of the total sales price of a product or service	Correa and Xavier (2013) Gopal et al. (2022)
Eco-conscious purchases	DT 10	The eco-conscious sourcing process benefits society	Gunasarekaran and Salanzani (2012)
Inventory administration	DT 11	Logistics pertains to the management of goods and services, including activities such as storage, procurement, and sales	Goli et al. (2023), Lo and Lin (2024)
Waste management	DT 12	Waste management within the supply chain encompasses the collection, transportation, disposal or recycling, and oversight of waste materials	Lu and Hung(2010), Sgarbossa Sgarbossa and Russo (2017), Zhang et al. (2024)

is used to sum up their views as stated by Margherita and Braccini (2023). The result is stated in the form of ISM model which shows the hierarchy of the determinants.

The Final ISM Model

Figure 1 specifies the levels of the determinants (DT), the cross-impact matrix analysis in Fig. 2 categorizes them based on their dependence and driving force. The final model for the semiconductor sector in Taiwan explains the relation between the determinants. It also shows the relation and relevance of each determinant on other. This is a hierarchical model. Figure 3 shows the interrelationship between various determinants.

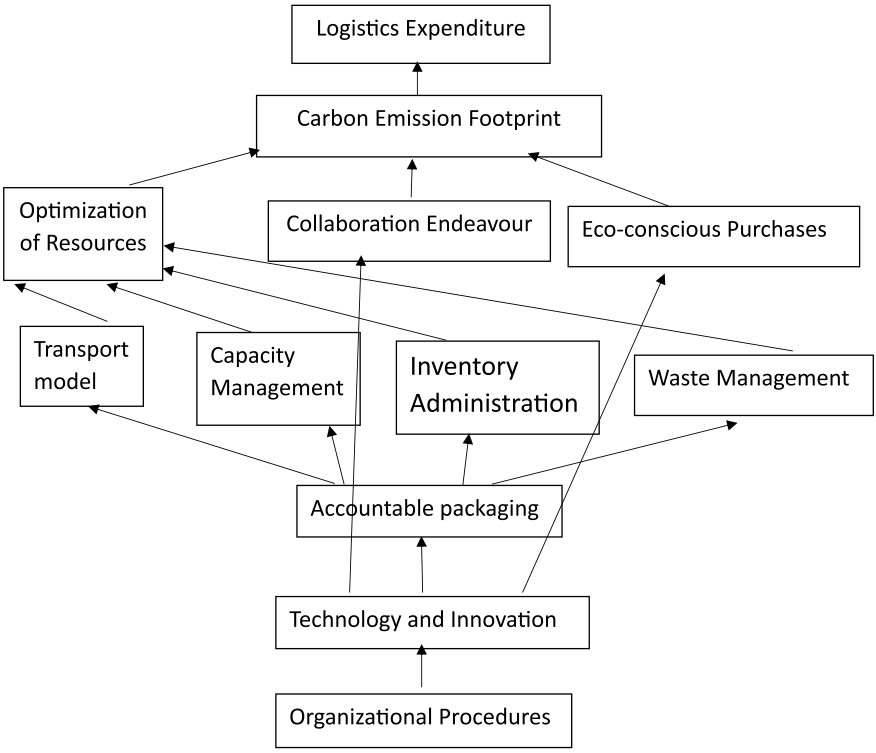


Fig. 1 ISM model of the determinants

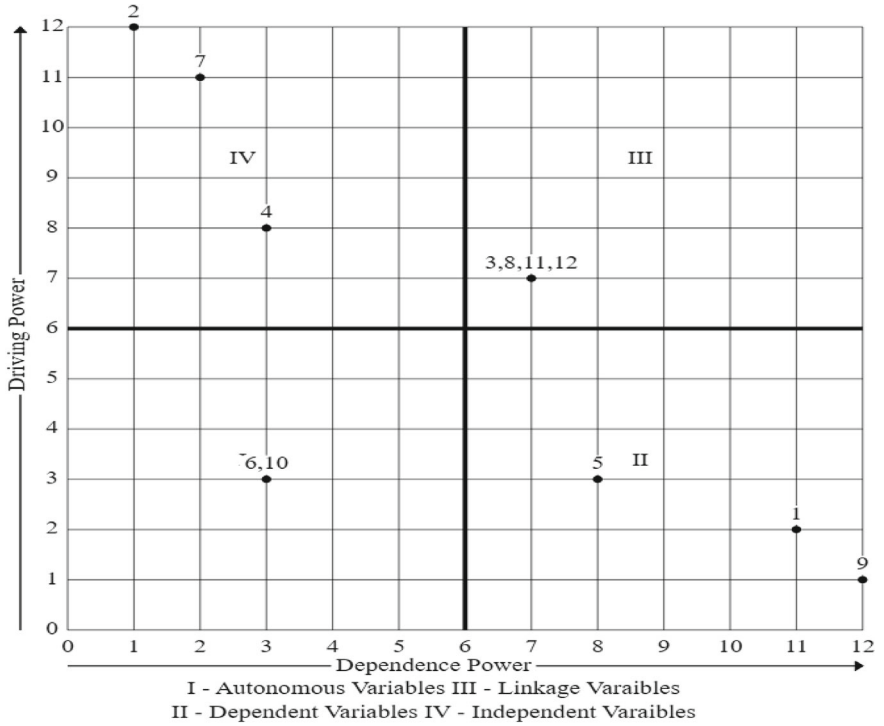
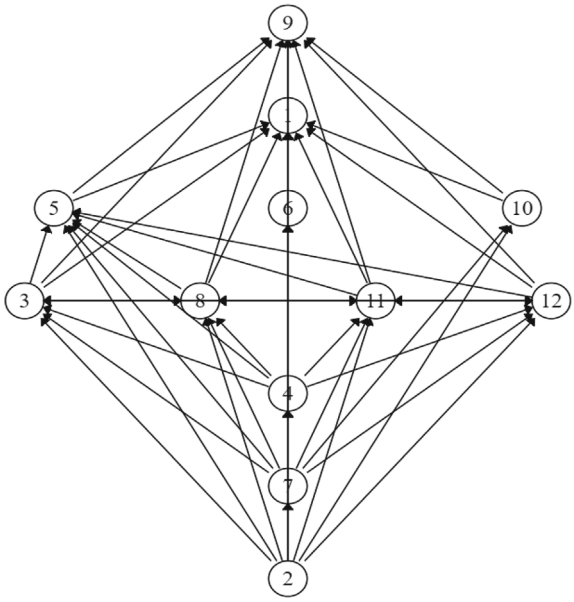


Fig. 2 Cross-impact matrix analysis

Fig. 3 Directed graph



Analysis and Deliberations

This research delineates a model illustrating the hierarchy of 12 identified determinants for sustainability within Taiwan's semiconductor supply chain (Fig. 1). Organisational Procedures (DT2) occupy the pinnacle of the paradigm, signifying its substantial impact on the other components, which include seven categories. This indicates that the embrace of Technology and Innovation depends on the execution of Organizational Procedures, which subsequently influence other critical elements across many levels. Accountable packaging (DT4) and other elements, such Transport model (DT3), capacity management (DT8), inventory administration (DT11), and waste management (DT12), are substantially enhanced by Technology and Innovation (DT7). By emphasizing product and process innovation, semiconductor firms may enhance operational efficiency and create a cost-effective, robust supply chain.

A comprehensive approach that integrates waste management, inventory control, capacity management, and transportation models is essential for Optimization of Resources (DT5). Effective resource management, bolstered by technology and innovation, promotes sustainability and strengthens collaborations with diverse stakeholders. These collaborations enhance the competitiveness, sustainability, and risk management of the semiconductor sector. The Logistics Expenditure (DT9) is substantially affected by the decrease in the Carbon Emission Footprint (DT1) at the highest level. The hierarchical model illustrates that the semiconductor industry's long-term economic viability and competitiveness are enhanced by the implementation of sustainable practices and innovation. The primary determinants (DT) that enhance the sustainability of the semiconductor supply chain have been discovered using Cross-Impact Matrix analysis, an established method for assessing variable effect. The study categorized the discovered Determinants (DT) into four quadrants—autonomous, dependent, linked, and driving—according to their effect or dependence, using the Cross-Impact Matrix Analysis.

Prospective Scope and Constraints

The authors endeavoured to systematically arrange the essential determinants of Taiwan's semiconductor industry's sustainable supply chain in a hierarchical structure. Nonetheless, the inquiry has intrinsic limitations that are eventually inescapable. Nonetheless, the representativeness and reliability of the findings may be undermined by the restricted sample size of participants. Future study should use a more comprehensive and varied sample to enhance the outcomes. Future study should include a thorough assessment and validation of survey tools to mitigate biases and enhance data accuracy. Defining the limits may enhance the comprehension of developmental potential and limitations. Future study on sustainable supply chain operations may use mixed techniques. The notion may be validated inside a real supply chain via pilot studies. The results from the Taiwan semiconductor sector may be generalized to

include many sectors and nations. Comparative assessments may enhance the understanding of sustainable supply chain operations. All future research must adhere to ethical norms. These limitations underscore the need for more study to enhance the scientific rigor and relevance of sustainability results within the semiconductor supply chain.

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Unfolding Association Between Smartphone Brands and Attributes Through Perceptual Map

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Abstract In marketing, brand positioning helps to establish a company's image distinctively in the target market. It enables the marketers to formulate the apt marketing policy and strategy to get an edge over the competitors in this complex and volatile post COVID scenario. In this research, we have made a humble effort to understand the positioning of the comparable brands of the Smartphone by developing a perceptual map. The seven comparable brands have been identified by emphasizing the respondents' views and consideration. While developing the perceptual map, the two most relevant dimensions have received adequate consideration–value for money and brand promotion. This study explores the interaction effect between brands and different relevant attributes. Thus, this research provides insight into assessing the positioning of similar brands of Smartphone along with attributes in the competitive market.

Keywords Comparable smartphone brands · Brand positioning · Perceptual map · Interaction effect · Correspondence analysis

Introduction

Mobile phones are now considered to be essential tools that are present in every aspect of human life, greatly surpassing their original purpose as simple communication devices in the contemporary societal dynamics setting. Owing to this significant societal change away from reliance on cell phones, smartphones have become

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an indispensable part of modern life, offering a plethora of convenient features. Although the widespread use of smartphones unquestionably improves convenience and productivity, it is imperative to acknowledge the potential adverse societal ramifications that may accompany their widespread existence. However, the prevalence of smartphones highlights their necessity in the modern world, leading people to become more selective in their choices.

The increasing integration of smartphones across different age groups and societal segments has led to greater rivalry among manufacturers, which in turn has promoted the creation of reasonably priced, high-quality products that cater to a wide spectrum of consumer preferences and needs. It is critical to comprehend consumer preferences and perceptions, particularly when it comes to brand positioning. According to Davis (2000), brand positioning is centred on consumers' subjective perceptions and requires a thorough grasp of their preferences and behaviours. Research by Kapferer (1992) highlights the significance of identifying distinctive value propositions and differentiators for brand distinctiveness in a highly competitive market. Furthermore, academics like Keller (1998) and Aaker (1996) emphasise how crucial it is to develop both points of differentiation and parity to establish a strong brand identity that encourages customer loyalty.

Following the disruptive COVID-19 pandemic, brands from various industries are facing challenges in navigating market uncertainties. Research conducted by Bapuji et al. (2020) and Boiral et al. (2021) highlights the significant influence of the pandemic on consumer behaviour, brand strategies, and market dynamics. As a result, businesses are forced to modify their positioning strategies to accommodate the changing attitudes and tastes of their customers.

In the world of smartphone brands, strategic positioning becomes critical due to growing competition and quickening technological progress. In order to distinguish between subtle differences in market positioning and consumer perceptions, it becomes imperative to use tools like perceptual mapping. Marketers can acquire insightful knowledge about consumer preferences by identifying points of similarity and difference between competing brands. This allows them to tailor brand strategies accordingly. The modern marketplace is dynamic and fiercely competitive, which emphasises how important brand positioning is to strategic success. Adopting a customer-centric strategy and utilising state-of-the-art tools and techniques help businesses navigate the complexity of today's business environment and establish memorable and long-lasting brand identities.

Literature Update

The literature review is a comprehensive study to have a better idea of a specific topic. In this study, we made an attempt to develop an idea regarding the relevancy of the term positioning in the present marketing scenario. To be more precise, this review sheds light on the positioning of smartphone brands.

Positioning

In the context of marketing strategy, positioning is essential for companies looking to boost their market share and obtain a competitive advantage (Cronshaw et al., 1990). It captures the intentional actions taken by a company to leave a lasting impression on its intended market (Kotler & Keller, 2009). By stressing important features and characteristics to their target market, brands strategically position themselves to stand out from the competition and develop a distinctive identity (Ansari et al., 1994). Establishing a positive consumer perception of the brand or product is positioning's ultimate goal, as it unlocks the fullest potential benefits. Developing a customer-centric value proposition requires following this process, which is essential (Kotler & Keller, 2009).

Laying a solid foundation for understanding and moulding consumer perceptions within a certain market niche allows businesses to create customised marketing policies and strategies that address the unique requirements and preferences of their clientele (Cravens & Piercy, 2009). Successful brand positioning is influenced by a wide range of elements, such as delivering high-quality products, adding value, encouraging innovation, focusing on a smaller range of products, embracing global viewpoints, and utilising the features and functional advantages of products (Aaker & McLoughlin, 2007).

Effective positioning strategies are built on the foundation of quality, which builds consumer trust and credibility. In a similar vein, providing value guarantees that customers view the brand or product as valuable and advantageous, which increases its appeal. Keeping a step ahead of the competition, brands can thrive in certain niches by concentrating on a small number of products (Cravens & Piercy, 2009). Brands can customise their messaging and offerings to meet the specific requirements of various consumer groups by emphasizing on distinct market segments.

Global perspectives allow brands to reach a wider range of consumers and reach beyond geographic boundaries, while functional benefits and product attributes draw attention to the real benefits of selecting a specific brand or product. In addition, the entire brand experience, emotional self-expression advantages, and organisational intangibles all play a role in influencing consumer perceptions and building brand loyalty.

Effective brand positioning is critical for success in today's dynamic and intensely competitive marketplace (Hooley et al., 2001). It offers a strategic road map for attaining sustainable growth and preserving a competitive advantage, acting as a compass for companies navigating the intricacies of the contemporary business environment. Organisations can drive long-term prosperity in the industry, foster brand loyalty, and build enduring relationships with customers by giving priority to positioning strategies that ring true for their intended audience.

Therefore, positioning continues to be a crucial part of contemporary marketing theory and practice, and companies looking to succeed in cutthroat markets should give it a lot of thought. Through the alignment of positioning strategies with consumer inclinations and market dynamics, organisations can produce a distinctive brand

identity, cultivate significant audience relationships, and achieve long-term success in the dynamic business environment.

Positioning of Smartphone Brands

Studying smartphone brand positioning has grown in significance since it provides information about consumer behaviour, market dynamics, and rivalry tactics in the smartphone sector. To illuminate the various factors influencing consumer perceptions and preferences regarding smartphone brands, this discussion explores a number of studies that were undertaken across various demographic and regional contexts.

A study by Yumusak et al. (2016) involved 400 students from Gazi University's Business Department who participated to build a perceptual map of smartphones. By concentrating on factors such as cost and display size, they sought to comprehend how students viewed different smartphone brands. Their results showed that Samsung and iPhone were closely related brands, indicating that students had a strong mental association with these brands. Conversely, though, there were perceived disparities between HTC, LG, and Sony, indicating that the positioning of these brands is different.

Building on these findings, Baran (2016) investigated how Turkish university students perceived various mobile phone brands. Baron used multidimensional scaling with a sample size of 417 respondents to create perceptual maps and establish the relative positioning of smartphone brands. The study indicates that students are most acquainted with Nokia, followed by Samsung, LG, Sony Ericsson, and General Mobile (GM). It's interesting to note that, when it comes to brand positioning, LG and Sony Ericsson were thought to be the most similar brands, while Nokia and GM were thought to be poles apart. This suggests that Turkish university students have different patterns of brand associations.

Similar to this, Lakshmi and Kavida (2018) looked into how college students in Chennai, India, used smartphones. Their research sought to determine the variables influencing brand positioning and the rationale behind smartphone selection, with 120 college students serving as respondents. The researchers also looked at how college students perceived different brands according to their gender, finding subtle differences in gender-based preferences and perceptions of brands.

By identifying factors that affect college students' perceptions of a brand in Tirupattur town, India, Sneha and Mary (2018) added to the conversation on smartphone brand positioning. Their study, which included 145 respondents as a sample, found a significant correlation between gender and brand positioning-influencing factors. Through an analysis of variations in brand perception based on gender, Sneha and Mary offered important insights into the complex interplay between demographic factors and brand preferences among university students.

Malonda and Pangemanan (2018) carried out a study on smartphone brand positioning in Manado, Indonesia, transcending geographical boundaries. Their study

sought to create a perceptual map for mid-range smartphone brands in the Indonesian market using a sample size of 120 respondents. Samsung was found by Malonda and Pangemanan to be the most favoured brand among respondents through descriptive statistics, underscoring the company's solid brand positioning in the Indonesian market. The report also recommended ways for Samsung to increase its market share by satisfying Indonesian consumers' preferences and providing smartphones at lower price points.

Lastly, the positioning of product attributes for smartphones made by Samsung and Asus was investigated by Aswin and Wahidun (2016). Their investigation aimed to comprehend consumers' perceptions of shape, features, work quality, and design, and how these factors affected brand positioning. The study's findings demonstrated differences in positioning according to features and reparation, highlighting the significance of particular product attributes in influencing consumers' perceptions of a brand.

When taken as a whole, these research enhance our understanding of smartphone brand positioning by exploring a range of aspects and variables that impact consumer attitudes and choices. Through the use of techniques like multidimensional scaling, qualitative analysis, and perceptual mapping, researchers hope to offer insightful information to the academic and business communities. Knowing the nuances of brand positioning in various demographic contexts helps businesses create marketing plans that work, improve their brand's reputation, and obtain an advantage over rivals in the ever-changing smartphone market.

Objectives of the Study

After doing a thorough literature review, we came across a number of studies where researchers heavily stressed brand positioning, regardless of whether they were concentrating on the brands themselves or their individual characteristics. Expanding on this groundwork, we aim to further the conversation by exploring the joint impact of brands and attributes in relation to smartphone positioning. This modest endeavour attempts to shed light on the overall picture of smartphone brand positioning by identifying the complex interactions between particular attributes and brand identity.

In order to accomplish this general aim, our research outlines particular goals intended to reveal the actual intricacy of smartphone brand positioning in the current market environment. The following are these goals:

1. **To research similar smartphone brands and their characteristics**: This goal comprises a thorough investigation of the different smartphone brands that are on the market, along with a thorough examination of the attributes that are related to each of these brands. Through a methodical classification and assessment of these characteristics, our goal is to obtain a more comprehensive comprehension of the various products available in the smartphone industry.

2. **To look at the connection between smartphone brands and the following characteristics**: Expanding on the identification of similar brands and their corresponding characteristics, the goal of this objective is to make sense of the intricate interaction that already exists between brands and the attributes that are linked with them. We aim to identify trends and connections that highlight the distinct positioning strategies used by various smartphone brands using empirical analysis and statistical methods.
3. **To create a multi-layered exhibit of smartphone brands and their characteristics**: Applying the insights from the earlier objectives, this goal is creating a multi-layered display that captures the positioning of smartphone brands and their key characteristics. We seek to give stakeholders a thorough visual depiction of the smartphone market environment through the use of sophisticated visualisation techniques like perceptual mapping and multidimensional scaling. This will aid in strategic decision-making and market positioning initiatives.

Our study aims to add to the current body of knowledge about smartphone brand positioning by integrating attribute-based and brand identity considerations from a holistic perspective, as achieved by pursuing these particular objectives. Our objective is to offer significant perspectives that can guide strategic choices in the fiercely competitive and ever-changing smartphone industry, by means of meticulous empirical investigation and inventive visualisation methods.

Research Methodology

Our investigation, which took place in the West Bengal state of India, focused on a sample of 360 individuals, age-groups comprise of 16 to 55. In order to obtain insights into smartphone brand positioning within this demographic, a representative cross-section of the population was ensured by selecting this sample size. We collected non-metric data from various regions of West Bengal using a structured questionnaire in an effort to capture several perspectives and opinions.

We used SPSS software to analyse our data using correspondence analysis (CA). In marketing research, CA is a well-respected method that performs really effectively when analysing categorical data (Benzécri, 1992). Since its inception almost half a century ago, CA has gained widespread use as a tool in social science domains such as ecology and marketing (Hoffman & Franke, 1986; Ter Braak, 1985). Known by a number of names, including categorical discriminant analysis, method of reciprocal averages, and dual scaling, CA breaks down complicated datasets to give a thorough explanation of the associations between the variables (Beh, 2004).

The development of a perceptual map, a visual aid that illustrates how consumers perceive the positioning of competing brands in the marketplace, was the main result of our investigation (Kardes et al., 2011). Understanding consumer preferences and spotting brand-specific strategic opportunities depend heavily on perception maps (Fripp, 2012). Value for money and brand promotion is the two main dimensions

Table 1 Demographic profile of respondents

Demographic Variable	Item	Frequency	Percentage %
Age	**16–25 years**	101	28.06
	26–35 years	108	30.00
	36 -45 years	83	23.05
	46–55 years	68	18.89
Gender	**Male**	197	54.72
	Female	163	45.28
Family Income	**Less than 50,000**	82	22.78
	50,000 -1,00,000	123	34.17
	1,00,000 -2,00,000	98	27.22
	More than 2,00,000	57	15.83
Occupation	**Unemployed**	98	27.22
	Business	83	23.06
	Professionals	64	17.78
	Service	115	31.94

Source Primary data collected through survey

that we identified in our study on the perceptual map. We included the respondents' demographic data, which shed light on the traits of the sample population, in order to put our findings into context. We were able to examine the perceptual map and comprehend how consumer perceptions of smartphone brands in the West Bengal region may be influenced by demographic factors, thanks to this thorough approach. Value for money, which considers factors like price, quality, and sustainability to attract potential customers, is a measurement of a brand's perceived value in proportion to its utility. Conversely, brand promotion highlights the tactics used by brands to enlighten, remind, and convince consumers, eventually drawing them to particular brands (Table 1).

Results and Discussion

A thorough representation of attribute preferences for the chosen smartphone brands under investigation is present in the Row Profiles table. The brands are represented by each row, and the weighted frequency of the attributes linked to each brand is shown in the columns. The weighted frequency, which is based on normalised values so that the total across all rows equals to 1, displays the relative significance of each attribute in relation to a certain brand. Due to this normalisation, attribute preferences across various brands can be compared, providing insightful information about the unique positioning strategies used by each brand in the smartphone market (Table 2).

Table 2 Row profiles

Brands	Attributes								
	Camera quality	Long lasting battery	Crystal clear display	Looks	After sales service	User friendly	Internal storage space	External storage space	Active Margin
Vivo	0.163	0.096	0.129	0.123	0.079	0.115	0.144	0.152	1.000
Oppo	0.165	0.108	0.141	0.112	0.086	0.110	0.129	0.150	1.000
Samsung	0.098	0.130	0.114	0.116	0.139	0.150	0.113	0.139	1.000
Redmi	0.119	0.128	0.111	0.124	0.139	0.139	0.111	0.129	1.000
Realme	0.129	0.129	0.119	0.134	0.098	0.138	0.108	0.146	1.000
Poco	0.141	0.127	0.151	0.112	0.087	0.109	0.112	0.161	1.000
Nokia	0.122	0.145	0.129	0.115	0.103	0.141	0.110	0.136	1.000
Mass	0.132	0.123	0.126	0.120	0.107	0.130	0.118	0.144	

Source Authors' Calculation

The Column Profiles table presents the weighted frequency of each attribute within each column, giving a thorough overview of attribute preferences across all selected smartphone brands. This illustration provides insightful information about the relative weight of particular attributes throughout the dataset; the values are normalised to guarantee that the total of all columns adds up to one. This table makes it easier to analyze in-depth the ways that different attributes affect the overall positioning of every smartphone brand in the market by displaying the weighted frequency of attributes relative to each brand. By consulting Table 3, readers can obtain a more sophisticated comprehension of the distinct weights assigned to distinct attributes by each brand, thereby enabling a comparative evaluation of brand positioning tactics.

Table 3 Column profiles

Brands	Attributes								
	Camera quality	Long lasting battery	Crystal clear display	Looks	After sales service	User friendly	Internal storage space	External storage space	Mass
Vivo	0.170	0.108	0.142	0.142	0.103	0.122	0.170	0.147	0.139
Oppo	0.170	0.120	0.153	0.128	0.111	0.116	0.150	0.143	0.137
Samsung	0.120	0.171	0.146	0.157	0.211	0.187	0.155	0.157	0.162
Redmi	0.153	0.176	0.149	0.176	0.222	0.182	0.160	0.153	0.170
Realme	0.148	0.160	0.144	0.171	0.141	0.162	0.140	0.155	0.153
Poco	0.124	0.120	0.140	0.108	0.095	0.098	0.111	0.131	0.116
Nokia	0.114	0.146	0.126	0.118	0.119	0.133	0.115	0.116	0.123
Active Margin	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

Source Authors' Calculation

One essential tool for deriving significant conclusions from the correspondence analysis conducted in this study presented in the summary table (Table 4). This table provides a succinct but thorough summary of the analysis's findings, highlighting important dimensions and how each contributes to the total variance the dataset explains. Table 4 presents a noteworthy finding: out of the six dimensions examined, only two can be interpreted. This implies that the most of the variance in the dataset is explained by these two dimensions. Dimensions 1 and 2 are important because together they account for 90.10% of the total inertia value, which is the amount of variance explained by the entire model relative to the original correspondence table. This highlights the important part these dimensions play in clarifying the underlying trends and connections between the variables being studied.

A closer look at the columns representing the Proportion of Inertia reveals how total inertia is distributed throughout each dimension. With 78.1% of the variance explained, dimension 1 is the main contributor. A further 12% of the variance is explained by dimension 2. The aforementioned distribution illustrates the respective significance of every dimension in encapsulating the fundamental structure of the data, with dimension 1 demonstrating a notable impact owing to its greater percentage of explained variance.

Offering a numerical indicator of the strength of the relationship, the Singular Value column sheds light on the canonical correlation between the variables within each dimension. Furthermore, a calculated Chi-square statistic larger than 0.05 suggests a significant association among the variables under investigation, confirming the Chi-square test results, which was used to assess the statistical association between rows and columns in the contingency table. This result supports the validity of the correspondence analysis results by indicating that the row and column variables show a meaningful association rather than being independent. Additionally, the Standard Deviation column shows how variable the Singular Values are, giving important details about how the data points are distributed within each dimension. A correlation coefficient of 0.029 indicates a weak correlation between dimension 1 and dimension 2, while the correlation column clarifies the degree of association between dimensions.

In a nutshell Table 4 provides a comprehensive overview of the correspondence analysis's findings, clarifying the main factors causing the dataset's variability and offering information on the correlations between the variables. Through the examination of variance distribution across dimensions and the evaluation of statistical significance of associations, researchers can acquire a more profound comprehension of the fundamental structure of data and extract practical insights to guide decision-making procedures.

An essential tool for evaluating the relative contributions of individual rows i.e., particular attributes in this case, the Overview Row Points table represents the dimensions generated by correspondence analysis. This table offers a comprehensive examination of the degree to which each row influences the dimensions and vice versa, which provides significant insights into the underlying structure of the data. The percentage of attributes linked to each row with regard to all of the brands included in the study is shown in the 'Mass' column. Researchers can identify patterns and

Table 4 Summary table

Dimension	Singular Value	Inertia	Chi-Square	Sig	Proportion of Inertia		Confidence Singular Value	
					Accounted for	Cumulative	Standard Deviation	Correlation
								2
1	0.114	0.013			0.781	0.781	0.017	0.029
2	0.045	0.002			0.120	0.901	0.017	
3	0.031	0.001			0.056	0.957		
4	0.020	0.000			0.024	0.981		
5	0.017	0.000			0.018	0.999		
6	0.005	0.000			0.001	1.000		
Total		0.017	57.827	0.053[a]	1.000	1.000		

[a] 42 degrees of freedom

Source Authors' Calculation

trends in attribute prevalence thanks to this metric, which provides an overall picture of the distribution of attributes throughout the dataset. This table highlights the importance of inertia once more by measuring the variation assigned to each row with respect to the overall inertia value obtained through correspondence analysis. Through the evaluation of the inertia values linked to specific rows, researchers can discern which attributes are most significantly accountable for the overall variability observed throughout the dataset.

Similar to factor or component loadings in other statistical analyses, the Point to Inertia of Dimension column contribution clarifies how each row influences the dimensions produced by correspondence analysis. This metric measures the extent to which each characteristic affects brand placement along the identified dimensions, offering insights into the relative importance of various qualities in driving the observed patterns. On the contrary, the contribution of Dimension to the Inertia of Point column clarifies the part that each dimension plays in determining how attributes are positioned within particular rows. Through the evaluation of these metric, researchers can ascertain the impact of each dimension on the arrangement of attributes, consequently acquiring a more profound comprehension of the basic structure of the data.

An in-depth summary of the total contributions made by each dimension to the arrangement of attributes within individual rows is reflected in the 'Total' column. This aggregate measure makes it easier for researchers to interpret correspondence analysis results by providing a consolidated view of all dimensions' combined influence on the observed patterns. Essentially, with reference to correspondence analysis, the Overview Row Points table provides a nuanced viewpoint on the relationship between attributes and dimensions. Researchers can find significant insights into the fundamental structure of dataset by examining each row's contribution to the dimensions and vice versa. This helps to guide decision-making processes and produce useful results (Table 5).

The Overview Column Points table assesses the extent to which each dimension contributes to the columns as well as the degree to which each column contributes to the dimensions. The 'Mass' column in this table specifically points out the proportion of attributes in regards to all brands. The amount of deviation with regard to the overall inertia value is again explained by inertia. The contribution of Point to Inertia of Dimension column indicates the role of each column and how it plays in each dimension; these are equivalent to factor or component loadings. The relevance and significance of each dimension in each column are demonstrated by the dimension's contribution to the Inertia of Point column. The total column concisely points out the sum of each dimension's role in respect to the column (Table 6).

This correspondence map (Fig. 1) displays the view of customers' regarding Smartphone brands in respect to two dimensions—Value for Money and Brand Promotion. If we give considerable weightage on value for money, Samsung and Redmi appear to be more accepted brands in comparison to others. Again if we emphasize brand promotion, Vivo, Oppo, Redmi and Samsung seem to be enticing the prospects more than other competitive brands considered for this study.

Table 5 Overview row points[a]

Brands	Mass	Score in Dimension		Inertia	Contribution				
		1	2		Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
					1	2	1	2	Total
Vivo	0.139	-0.457	0.291	0.004	0.254	0.262	0.841	0.133	0.974
Oppo	0.137	-0.410	0.059	0.003	0.202	0.011	0.939	0.008	0.946
Samsung	0.162	0.440	0.066	0.004	0.274	0.016	0.932	0.008	0.940
Redmi	0.170	0.344	0.189	0.003	0.175	0.136	0.837	0.099	0.936
Realme	0.153	0.042	-0.102	0.001	0.002	0.036	0.046	0.104	0.149
Poco	0.116	-0.273	-0.348	0.002	0.076	0.316	0.538	0.344	0.882
Nokia	0.123	0.124	-0.284	0.001	0.017	0.223	0.252	0.516	0.767
Active Total	1.000			0.017	1.000	1.000			

[a] Symmetrical normalization
Source Authors' Calculation

The perceptual map as depicted in Fig. 2, concisely indicates the interaction effect between Smartphone brands and the attributes the brands offer. The perceptual map makes it quite evident that there is a stiff rivalry exists between Samsung and Redmi in the Smartphone segment. The intense competition appears to be there with respect to the attributes like user-friendly approach, after-sales service, and looks. Conversely, when it comes to features like internal storage capacity and camera quality, Vivo and Oppo are definitely in rivalry. The attributes like crystal clear display give a unique identity to Poco. Realmi and Nokia share the same quadrant along with the attribute long-lasting battery. These interpretations as reflected in Fig. 2 are more clear and precise in comparison to Fig. 1 since the combined effect of the attributes and brands are aptly depicted in the same figure. Thus, interpretive precision helps us to assume the strategic positioning more accurately, logically, and successfully.

Conclusion and Managerial Implication

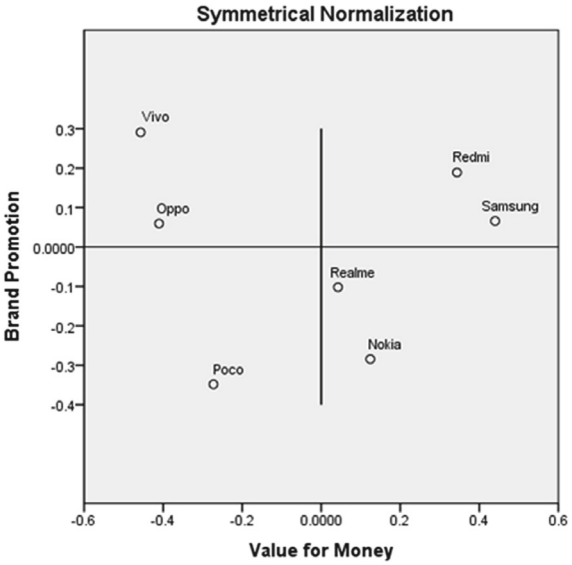
In this present scenario, it has been clearly observed that customers' purchasing habits have significantly changed. This shift has been occurring as a result of the drastic change in consumers' tastes and preferences in the post COVID era. The marketers have no other option, but to pay considerable heed in this matter. They have to be very specific and conscious about the attributes of the products. It is high time now that the marketers of Smartphone should start emphasizing on the brand positioning. Due to the market's increased complexity and volatility, it is of utmost necessity to explore the association between the brands and attributes. The interaction effect between

Table 6 Overview Column points[a]

Attributes	Mass	Score in Dimension		Inertia	Contribution				
		1	2		Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
					1	2	1	2	Total
Camera quality	0.132	-0.490	0.127	0.004	0.278	0.047	0.936	0.024	0.961
Long lasting battery	0.123	0.259	-0.365	0.002	0.072	0.366	0.542	0.421	0.962
Crystal clear display	0.126	-0.250	-0.246	0.001	0.069	0.171	0.634	0.240	0.874
Looks	0.120	0.038	0.083	0.000	0.001	0.018	0.040	0.075	0.115
After sales service	0.107	0.625	0.249	0.005	0.365	0.148	0.889	0.055	0.944
User friendly	0.130	0.334	0.014	0.002	0.127	0.001	0.888	0.001	0.889
Internal storage space	0.118	-0.227	0.290	0.001	0.053	0.221	0.541	0.345	0.886
External storage space	0.144	-0.164	-0.092	0.001	0.034	0.027	0.653	0.080	0.733
Active Total	1.000			0.017	1.000	1.000			

[a] Symmetrical normalization
Source Authors' Calculation

brands and attributes would reflect the true picture of the market. It would give ease to the marketers to frame the marketing strategies aptly and diligently. This marketing approach benefits them in addition to entice the prospects but also to get an edge over the rivals. It is even more applicable for Smartphone brands as it is growing steadily over time. This study helps to unearth the positioning of the comparable Smartphone brands in relation to attributes the prospects are looking for. The Indian consumers are price-sensitive, therefore, consumers are looking for brands that have already shown value to them. For that reason, we pay due consideration to value for money as one of our dimensions. It is even true to inform and persuade the customers at every instant to make the prospects get connected with the brands. We have selected brand promotion as our second dimension since the marketers are always keen to get them related in the competitive market. A piece of considerable knowledge regarding the perceptual map that reflects the combined effect between the brands and attributes



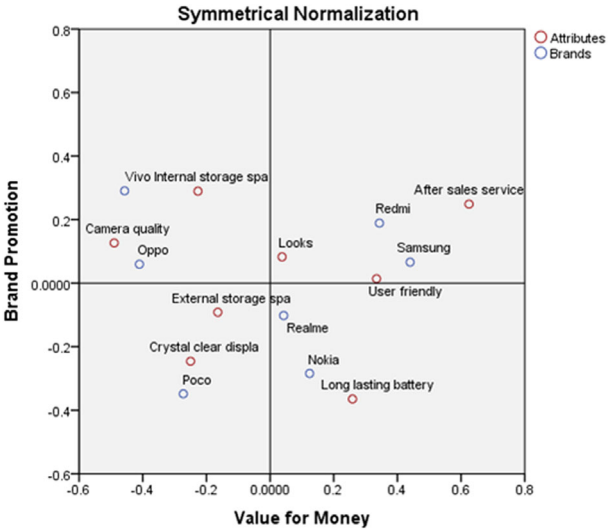


Fig. 1 Perceptual map of smartphone brands

Fig. 2 Perceptual map displaying association between smartphone brands and attributes

considering the relative importance to two dimensions would definitely help the marketers to reap a rich dividend in the long run.

Future Scope of Research

It is become increasingly significant to explore the complex dynamics influencing smartphone brand positioning as the global smartphone market continues to change rapidly. Through an analysis of emerging markets, technological developments, cross-cultural disparities, and longitudinal patterns, scholars can acquire significant understanding of the dynamic consumer preferences and brand perceptions within the smartphone sector.

(a) **Investigating Emerging Markets**: Future studies could focus on comprehending smartphone brand positioning in developing nations, where smartphone adoption is quickly rising, like Southeast Asian and African countries. Examining the ways in which cultural subtleties and economic considerations impact consumer attitudes and multinational smartphone companies could gain valuable insights from brand selections.
(b) **Integration of Technological Advancements**: Future research may examine the effects of new technologies on smartphone brand positioning, such as 5G connectivity, augmented reality (AR), or artificial intelligence (AI). This is because technology is always advancing. To stay competitive, smartphone manufacturers need to understand how these technology developments affect consumer choices and brand impressions.
(c) **Cross-Cultural Analysis**: Comparing smartphone brand positioning across various locales and cultures through cross-cultural research may provide more profound understanding of the universality or cultural specificity of consumer preferences. Multinational smartphone manufacturers would benefit strategically from an analysis of how brand perceptions differ in various cultural contexts.
(d) **Longitudinal Studies**: To monitor shifts in smartphone brand positioning over time, future studies may employ longitudinal methodologies. Through the observation of changes in consumer preferences, market dynamics, and technological advancements, scholars can acquire a thorough comprehension of the dynamic smartphone landscape and develop flexible brand positioning tactics correspondingly.

Limitations of the Study

Understanding the potential influences on the scope and complexity of the results is essential to understanding the intrinsic constraints of the present investigation. Future research initiatives seek to improve the sample size, research methodology limitations, temporal constraints, attribute selection, and cultural contextual factors in order to strengthen and make insights into smartphone brand positioning more applicable.

(a) **Sample Size and Geographic Scope**: The study's geographic focus and sample size were restricted to West Bengal, India, which may have limited applicability to larger populations and markets. Future research should consider larger and more varied samples from different places in order to improve the external validity of the results.
(b) **Research Methodology Constraints**: The majority of the non-metric data used in the study were gathered via a structured questionnaire and examined via correspondence analysis. Qualitative and quantitative approaches may be combined in future studies to obtain a more sophisticated comprehension of smartphone brand positioning, despite the fact that this method provided valuable perspectives into consumer attitude.
(c) **Temporal Constraints**: The cross-sectional study design took a momentary picture of smartphone brand positioning. Future studies could employ longitudinal designs to track changes in consumer preferences and brand perceptions over time in order to provide a more comprehensive and dynamic knowledge of the smartphone brand positioning.
(d) **Selection and Measurement of Attributes**: The study ignored possibly significant factors like product features, design aesthetics, and user experience in favour of concentrating on particular attributes like value for money and brand promotion. Future studies should make use of more attributes and proven measuring scales to guarantee comprehensive coverage and accurate assessment.
(e) **Cultural and Contextual Factors**: These factors were not expressly considered in this study, despite the possibility that they have an effect on smartphone brand positioning. Future studies should look at how cultural norms, societal values, and market dynamics affect customer perceptions and brand preferences in order to provide a more culturally sensitive analysis.

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Tobacco Economics, Banks, and Mindful Solutions for Long-Term Sustainability

Ranjit Singha and Surjit Singha

Abstract To sustain the incomes, one must implement multiple cropping systems for farmers who grow their crops in India's tobacco industry. The inflation in urban/rural areas may signal tax evasion and require regulation. When standards are not met, trade in illicit products appears; it can negatively affect a country's economic and environmental future. There is hope in reshaping mindfulness practices for tobacco control and public health. As of June 2024, the cigarette market volume in India is US$13,370.0 million. From 2022 to June 2024, India's cigarette market volume increased to $1.29 billion. As of June 2024, China's cigarette market volume is $285,130 million, more than India's. From 2022 to June 2024, China's cigarette market volume has increased by US $10,800 million. China's cigarette market volume has increased by US$ 9.51 billion more than India's. Both China's and India's cigarette consumption has increased. AI and virtual reality may aid addiction recovery. Comprehensive strategies, including establishing de-addiction centres, implementing psychoeducation, developing a new intervention manual, developing new interventions, developing new assessment tools, and policy changes, a need to reduce tobacco consumption and address underlying causes. Incorporating mindful methods, new assessment tools, and proper formulation into an economic approach can help curb tobacco consumption sustainably while improving public health.

Keywords Sustainable transformation · Multi-crop cultivation · Golden leaf documents · Tobacco-related strategies · Tobacco addiction · Multimedia meditation · Illegal cigarette influx · Sustainable agriculture training

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Introduction

Tobacco is injurious to health. Even though India is facing regulatory interventions such as statutory warnings and the depiction of pictures on cigarette cartons, tobacco consumption continues to be on the rise in the country. India stands in second place in the world tobacco consumption, with China standing one step ahead. The pervasive nature of this issue underscores the conflicting priorities between profit-driven tobacco interests and public health issues by paradoxically making warnings ineffective. A stark asymmetry arises in the web of India's tobacco industry, in which a few companies make vast fortunes.

On the other hand, tobacco producers are fixed on prices determined by the significant purchasers and, therefore, preserve a monopolistic market structure. The country showed a significant commitment to international efforts to reduce harm from tobacco use when it ratified the WHO Framework Convention on Tobacco Control (WHO FCTC) in 2004. So, in 2018, the Government of India took a giant leap, ensuring that legitimate trade in India is not crippled but, at the same time, the gains of public health in India are also not compromised. This strategic manoeuvre aimed to achieve two objectives: to control the fast-rising illicit trade and save the legitimate tobacco industry from falling. However, even with these regulations, the monopolization of the five big tobacco companies continues, leading to probing questions about the power base in the industry and the market itself.

India is a pioneer with footprints at impressive milestones, impacting the most significant tobacco treaty—the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC)—and implementing targeted policies to disrupt the illicit tobacco trade. Although this interplay between industry interest and public health objectives is a common issue, this highlights the need to update the tobacco regulation in India. This aligns with Article 12 (Education, Communication, Training and Public Awareness), which lays down the importance of education and public awareness (in line with India's National Education Policy 2020). Its concrete implementation, however, must be improved. This is because an unintended consequence of promoting Article 8 (Protection from Exposure to Tobacco Smoke) is that other Articles related to secondhand smoke may be inadvertently left screaming for attention and not with proper follow-up. Article 17 (Provision of Support for Economically Viable Alternatives) helps foster sustainable livelihoods without tobacco cultivation and proposes a strategy that covers all health harms and socioeconomic dimensions.

Nonetheless, the wide availability of illicit tobacco products brings with it fiscal concerns to the government and health outcomes to the country. Tobacco advertising has little respect for prohibitions, maintaining its harmful messages for the reinforcement of smoking. We need a multifaceted approach to fix this issue, which is deep-rooted in our society. Critical interventions include strengthening infrastructure for de-addiction, cancer treatment, awareness, and advocacy for alternative livelihoods in rural areas. Technology facilitates communication and can support exposure, and there is emerging evidence on the effectiveness of mindfulness-based

interventions for addiction (Demina et al., 2023; Garland & Howard, 2018; Trujols, 2020; Wilson et al., 2017). Still, unique solutions are necessary to end the illegal tobacco trade without simply jacking up cigarette taxes. The reason is that making money, protecting the environment, and running the business depend dynamically on one another. Achieving inclusive development requires complete training and support to transition the tobacco growers to alternative crops. However, India is at a juncture where it must tiptoe into this complex topography of reconciling economic concerns with public health obligations. Staying the course with a proactive response and adherence to WHO guidelines will be central to creating a healthier and fairer future for all as the nation steers its new path.

The landscape of the tobacco industry in India is a complex one as it deals with severe societal, economic, and health implications. The industry includes a range of actors, from tobacco growers to end-users, manufacturers and regulators. Economic pressures, health effects of smoking and smoking prevalence, the regulatory framework over tobacco advertising and sales, and the challenges facing tobacco farmers are all pieces of the puzzle when it comes to understanding this industry. Similarly, investigating differences between rural and urban areas or focusing on specific regions within India may provide additional insights into the complex processes affecting tobacco production, utilization, and regulation.

The objective of the current study was to comprehensively analyze India's tobacco sector, covering economic, social and health dimensions. A deeper understanding of the tobacco industry is developed by evaluating factors like economic output, tobacco consumption, policy reform, and industry challenges. Moreover, the research tries to identify differences in tobacco-related factors and outcomes using a comparative analysis across urban and rural regions or focusing on specific territories.

This research covers a comprehensive study of various aspects of the tobacco industry in India. It requires looking at the financial performance of the industry, the number of people smoking and the health risks that it causes, the tobacco regulation environment and the challenges facing the producers of tobacco. We may need to dig deeper to understand the differences between rural and urban and focus on specific geographical locations in India to provide an overarching view of the tobacco industry.

This study is based on theories constructed within sociology, economics, public health and related fields. We use policy diffusion, health behaviour models, supply and demand, and market dynamics to assess the driving factors behind tobacco production, consumption, and regulation in India. The study aims to draw on these theoretical frameworks and synthesize them into a holistic model that can scrutinize the complex characteristics of the tobacco sector.

Political economy, Public Policy, social determinants of health, and economic development theories are the theoretical framework of this study. These models inform tobacco use aetiology, the role of socioeconomic factors in smoking trends, and the role of Policy, respectively. Using these theoretical frameworks, the study also endeavours to improve our understanding of the fundamental processes modulating the Indian tobacco industry.

Table 1 Illegal Tobacco of 2021 as reported in media

Months/Year[1]	Value US $
Jan 2021–March 2021	8080828
April 2021–June 2021	1474711
July 2021–Sept 2021	2517571
Oct 2021–Dec 2021	2469439
Jan 2022–March 2022	530789
April 2022–June 2022	1820994
July 2022–Sept 2022	8964585
Oct 2022–Dec 2022	4978152

The conceptual framework, theoretical framework, background, objective, and scope provide a complete structure for exploring the complexities of the tobacco industry in India. This study is designed to generate information to inform Policy, practice, and future research in the crucial field. As such, it has been conducted with the greatest of care, considering and combining multiple perspectives.

Data in this chapter is from secondary sources, including national statistical bodies, international agencies, and trade associations. For the study, we collected information on illicit tobacco. We implicated illicit tobacco themes with the aid of the relevant keywords from 2012 through 2023, such as "illicit tobacco from India," "cigarette excise tax in India," and "strategic approaches within the tobacco industry." The review applied a systematic literature model to explore the global tobacco products industry, examine market trends, and deliver independent market forecasts.

This is a report on a study concerning one of the manifestations of the tobacco epidemic in India, and it aims to address several research questions. The extent of the prevalence of counterfeit cigarettes, the impact of seized illicit tobacco in India upon farmers, excise tax rates on cigarettes in India, India's compliance with global standards for cigarette taxation, patterns of tobacco consumption in India, strategic approaches by the tobacco industry, the health consequences of tobacco use in India, efforts by Indian financial institutions to promote the tobacco industry.

Legal and Illegal Tobacco

As tobacco prices are growing, so we have illegal tobacco. Growing by well over 100% above inflation, the rising prices of tobacco are a significant driver for illegal tobacco (Table 1).

The increase in value of illicit cigarette seizures in India from around $14,542,549 in December 2021 to $15,763,731 by December 2022 went up. These seizures rose

[1] The Tobacco Institute of India. (2020). *Spurt in Illegal Cigarette Seizures in India.* TIIOnline. https://www.tiionline.org/spurt-in-illegal-cigarette-seizures-in-india-table.

Table 2 Illegal Tobacco of 2023 as reported in media

Months/Year[2]	Value US $
Jan 2023–March 2023	1,759,285
April 2023–June 2023	1,478,571

Table 3 Excise tax on cigarette price

WHO Record of International Benchmark[3]	India[4]
A minimum of 71–75% Excise Tax is included in the retail price recorded by WHO in most countries, especially Europe	31.22% Excise Tax is included in the Retail Price during 2021. 45% excise tax is included in the retail price during 2022

by $1,221,182, a straightforward example of ongoing challenges. Seized cigarettes are typically destroyed, emitting emissions that are equivalent to the combustion of cigarettes offenders have smoked on top of that, the cost of illegal tobacco storage means operating costs. While incineration, contrary to the popular belief, does not directly lead to the loss of tax revenue, it does involve many environmental risks. It leads to higher costs, illustrating the complex consequences of handling illicit tobacco issues (Table 2).

Between January and March 2023 (during the first quarter), the overall value of the illegal entry of cigarettes amounted to approximately $1,759,285. The combined stream of cigarettes was valued at around $1.5 m between April and June 2023. By cross-checking this data with data from 2021 and 2022, it can be determined that the numbers in the half-yearly report 2023 show a decrease in the inflow of illegal cigarettes. The movement of contraband cigarettes could also show a decline in 2023, after several years of mass seizures of illicit cigarettes, said IARC (Table 3).

Excise taxes on tobacco will be lowered until (in 2022) India's tax only accounts for 45% of the retail price, far short of the WHO recommended range of 71–75%. The discrepancy above illustrates how important it is to align taxation policies with international standards to support tobacco control efforts better. Following guidelines from the World Health Organization (WHO) ensures universal compliance and augments public health efforts, thereby stressing the forward nature of controlling tobacco (Table 4).

India (the world's 2nd most significant consumer of tobacco) finds itself in the unique position of marketing to a smoking target audience (adults). Despite the health risks, such as the development of cancer, tobacco companies continue to seduce

[2] The Tobacco Institute of India. (2020). *Spurt in Illegal Cigarette Seizures in India.* TIIOnline. https://www.tiionline.org/spurt-in-illegal-cigarette-seizures-in-india-table.

[3] Chaloupka et al. (2020). Tobacconomics cigarette Tax scorecard. *Chicago, IL, USA: Institute for Health Research and Policy, University of Illinois Chicago.* https://www.tobacconomics.org/files/research/741/tobacco-scorecard-2nd-ed-policy-note-tax-share-v2-final.pdf.

[4] CBIC. (2022). *Valuation of tobacco and tobacco products to pay basic excise duty and national calamity contingent duty.* https://www.cbic.gov.in/resources//htdocs-cbec/excise/cx-circulars/cx-circulars-2022/Circular_No_1082_03_2022-CX.pdf.

Table 4 Tobacco consumption in India[5]

Users	Number
Tobacco users in India	267 million
Among adults (age 15+)	28.6%, among that man 42.4% and women, 14.2%
Adults use smokeless tobacco	21.4%; men 29.6%; women 12.8%
Adults smoke	10.7%; men 19.0%; women 2.0%
Adult smokers smoke bidis	7%
Among youth (ages 13–15)	Presently, 14.6% of individuals engage in tobacco consumption in various forms, with the breakdown revealing that 19.0% are boys and 8.3% are girls. Specifically, 4.4% of this group smoke cigarettes, while 12.5% consume alternative tobacco products

consumers with images of fortitude and pleasure. There is, of course, another aspect to recall here, which is the allure of short-term gratification in the dane of longer-term health in terms of tobacco consumption, that illustrates the complex relationships that could exist between desire and risky behaviours (Table 5).

At the same time, many financial institutions (including several owned by the government) continue to have substantial investments in the cigarette industry, so they are still indirectly supporting it. Government intervention, as seen in investments made by LIC and SUUTI (for instance, in companies like ITC and VST Industries), underlines the criticality of state involvement. This provides billions of dollars to be invested in businesses that produce sugar (including corn) and re-invest. The magnitude of the government-affiliated support for the tobacco industry is best illustrated with LIC's stakes in ITC and VST Industries (Table 6).

The current expenditure "rose by billions" from previous estimates predicted, and the total economic burden of medical expenses attributable to smoking has substantially climbed from 2011–2012. Based on statistics from 2021–2022 brings a horrid reality that the overall economic burden of USD 6,870,934,350 billion due to the SHS (Secondhand Smoke) from tobacco. This data implies that the direct medical expenses and overall financial burden of tobacco use will continue to grow, with the consequences of high costs allocated differently between direct smokers and non-smokers.

[5] WHO. (2019). *Tobacco*. https://www.who.int/india/health-topics/tobacco.

Table 5 Financial institution of India and investment in the tobacco industry of India[6]

Name of the investing organization	Name of the receiving organization	Year	Amount
Life Insurance Corporation of India (LIC)[7]	ITC	2010–2011	4,36,210.92 US $
The Specified Undertaking of the Unit Trust of India (SUUTI)	ITC	2011–2012	30.25% stake in ITC worth about 137711US $
LIC	VST Industries and Dharmapal Satyapal (DS) Ltd	2009–2010	61,79,838.30 US $
LIC	VST Industries and Dharmapal Satyapal (DS) Ltd	2011–2012	1,19,95,869.60 US $
General Insurance Co., New India Assurance Co., Oriental Insurance Co. and National Insurance Co. New India Assurance	VST Industries and Dharmapal Satyapal (DS) Ltd	2017–2018	1.71% stake in VST Industries

Table 6 India's Medical expenditure for tobacco-related Illness[8]

Year	Amount
2011–2012	22.4 Billion US $, total economic cost
2011–2012	3.6 Billion US $ direct medical cost
2017–2018	27.5 Billion US $, total economic cost
2017–2018	6 Billion US $, direct medical cost
2021–2022	6,87,09,34,350 Billion US $, Six billion eight hundred seventy million nine hundred thirty-four thousand three hundred fifty Billion US$ Total economic cost because of Second Hand Smoke (tobacco)

[6] ET Bureau. (2017). *Bombay High Court notified the Union government of PIL filed against its stake in ITC*. The Economic Times. https://economictimes.indiatimes.com/industry/cons-products/tobacco/bombay-high-court-issue-notice-to-union-government-on-pil-filed-against-its-stake-in-itc/articleshow/58225204.cms.

[7] Money Life. (2011). *The Life Insurance Corporation coughs up crores for tobacco investments.* https://www.moneylife.in/article/the-life-insurance-corporation-coughs-up-crores-for-tobacco-investments/20555.html.

[8] John et al. (2015). Economic burden of tobacco-related diseases in India. *New Delhi: Ministry of Health and Family Welfare, Government of India.* https://www.who.int/docs/default-source/searo/india/tobacoo/economic-burden-of-tobacco-related-diseases-in-india-executive-summary.pdf.

Tobacco, Health, Mindfulness Solution

Secondhand smoke has vast repercussions, as Torres et al. (2018) demonstrate in a study that includes the environment, many life forms, and neighbours. Even in the COVID-19 pandemic era, Gibbs et al. (2016) argue that there is an urgent need to ban smoking in households and public places. According to Jiang et al. (2020), smoking will leave you vulnerable to infection with SARS, respiratory and digestive diseases, or leprosy, as well as COVID-19. Based on research, Patanavanich et al. (2020) emphasize that smokers are at particular risk of suffering from COVID-19. Oliveira (2011) found that secondhand smoke exposure increases the incidence of lower respiratory infection in infants, especially bronchiolitis. Significant risks are posed to the babies of smoking mothers. Therefore, reducing the risk of passive inhalation by children was crucial. Thus, they can maintain good health. Li et al. (2021) discuss the historical relationship between tobacco use and severe COVID-19 infections, suggesting that stringent smoking cessation measures should be imposed. Mindfulness activities include Tai Chi, pack philosophy workshops, and smoking cessation coaching for young people Tang et al. (2013); other studies suggest that meditation can reduce smoking. Postural and body scan exercises, on the other hand, Ussher et al. (2009), help us better resist craving for cigarette withdrawal symptoms. Finally, Cropley et al. (2007) recommend that implementing a course of regular relaxation exercises is an effective strategy to overcome the difficulties associated with stopping smoking.

Targeted Marketing by Location

Tobacco advertising subtly speaks for gratification, romance, fashion, independence, pleasure, and empowerment (Dahl, 2004). People put up with perceived hazards for perceived benefits (Beyth et al., 1997). There is an urgent need to ban the world from promoting negative things like alcohol and drugs, especially surrogate advertising, in so far as they affect aimless youth whose appetite for taking risks is on the up (Beyth et al., 1997). Those young and elderly smokers are equally affected by the rewards of smoking (Cox et al., 2008).

The tobacco industry targets youth and women. Smoking is predominantly female population, accounting for at least 20% according to current statistics (Cox et al., 2008). The number of women smokers is going up in the developed world. The industry targets a more significant number of female cigarette smokers than men; even rates of smokers for both genders are almost equal. Despite the widely acknowledged health hazards, particularly those stemming from secondhand smoke, smoking and snuff remain hazardous behaviours (Kaleta et al., 2011).

Tobacco companies employ marketing principles on a mass scale aimed at distribution and communication as a means of product promotion (Greenland et al., 2020; Kotler & Levy, 1969; Langley, 2024; Levy et al., 2022). Eventually, tax increases

Table 7 Global comparison 2022[9]

Name of the Country	Revenue
China	287,700 Million US$
United States	105, 200 Million US$
Germany	39,240 Million US$
Indonesia	34,610 Million US$
United Kingdom	27,460 Million US$
India	12.08 Billion US$

Table 8 A global comparison 2024[9]

Name of the Country	Revenue
India	13,370.0 Million US$
China	298,500 Million US$

to global cigarette sales notwithstanding, it is a fact that tobacco companies need more imaginative advertising strategies to raise their profits (Apollonio & Glantz, 2019; Kotler & Levy, 1969; Levy et al., 2022). The appearance of mobile advertising has brought new promise to tobacco companies who need to market their product. Witness the recent resurgence of traditional and electronic nicotine delivery systems (Apollonio & Glantz, 2019; Cantrell et al., 2017; Levy et al., 2022; Ling et al., 2022). Many tobacco-containing products sold via mobile-optimized websites and smartphone apps became visible. However, evidence that no controls were in place was apparent to anyone who followed this kind of outlet ((Ling et al., 2022; O'Brien et al., 2018). Despite regulatory restrictions, mobile apps and sites in India traffic tobacco-based products. The use of mobile marketing in India is on the rise, thanks to a high rate of smartphone usage among Generation Y (Stocchi et al., 2021). The demonetization of currency and the widespread adoption of translation apps during the COVID-19 lockdown in India gave cigarette companies—like other businesses—a better chance to reach out to adolescents (Shukla et al., 2021). However, all of these exchanges bear on the implicit and explicit promotion of tobacco-related products in India (Tables 7, 8 and 9).

Reaping the financial benefits of tobacco production is a task filled with hazards for India's farmers. For example, even though they must face most of the dangers associated with growing tobacco and endure their own body's infections caused by times of exposure to toxic pesticides in return, they are not even paid for these efforts (Lencucha et al., 2022; McKay et al., 2015; Natarajan, 2017; Ravi et al., 2024). Nevertheless, from the pandemic to the crisis, companies in the Indian tobacco industry, which has owned a monopoly over tobacco products, have developed healthy profits and have been little affected by it. Chinese companies are taking a similar path (Barnett & Peng, 2021; Hefler & Gartner, 2020; Liao & Cole, 2021; Yadav et al.,

[9] Statista. (2024). *Tobacco Products—India.* https://www.statista.com/outlook/cmo/tobacco-products/india?currency=USD#analyst-opinion.

Table 9 Indian tobacco exported quantity and revenue[10]

Years/Month/ Date	Some Facts
2021–2022	From 2021 to 2022, 1.11 million tons of FCV tobacco were recorded
April 2022	In April 2022, there was a recorded total of 15,047 tons (estimated at approximately 52 million US dollars), showcasing a significant increase of 61% compared to the same month of the previous year
2021–2022	Between 2021 and 2022, 1.81 million tons of unprocessed tobacco were exported
February 2022	In February 2022, India shipped tobacco valued at 78 million US dollars, reflecting a 12.78% upswing compared to February 2021. Additionally, there was a noteworthy 20% growth in exports from February 2021 to February 2022. From November 2021 to February 2022, India observed a yearly increment of 7.6% in its tobacco exports
April and May 2022	During April and May 2022, there were notable increases in the exports of raw tobacco, with a surge of 51% and 14%, respectively, when compared to the corresponding timeframes of the previous year
2021–22	For the fiscal year 2021–22, the export value totalled 923.8 million US dollars

2021; Zheng, 2018). For example, even though they are no longer as popular among consumers as before, there are profound regulations and public health consciousness, smoking levels decline each time, and the sales volume falls; their response is always to increase prices one way or another. However, in India, there are cheaper versions of cigarettes, called beri; the rationale for increasing the cigarette price may not work in India, or the rationale for increasing tax to increase the price of cigarettes may not work for India. The only way for India to increase awareness is through psychoeducation. Statista. (2024) As of June 2024, the cigarette market volume of India is US$13,370.0 million. So, cigarette consumption in India has remained the same but has increased. From 2022 to June 2024, India's cigarette market volume increased to $1.29 billion. Till June 2024, China's cigarette market volume is $285,130 million more than India's. From 2022 to June 2024, China's cigarette market volume has increased by US $10,800 million. China's cigarette market volume has increased by US $9.51 billion more than India's. In terms of profits, China dominates the global tobacco market. Compared to China, India is merely an insignificant second-rate exporter that can only rely on providing cheap labour for overseas production facilities.

To raise their profits, tobacco companies try to expand the range of items they offer and tap into new generations, like new flavours, eye-catching designs, and new colour combinations. Moreover, now, India's exports of tobacco products—such as cigars, smoking tobacco, strip tobacco, etc.—are proliferating. In these expanding markets and exports, however, a gap remains between the economic profits of mighty

[10] IBEF. (2022). *The tobacco industry and exports to India.* India Brand Equity Foundation. https://www.ibef.org/exports/tobacco-industry-india.

Table 10 The Consumer Price Index of the pan, tobacco, and intoxicants across rural India for August 2021 and August 2022[11]

Description	August 21 index (Final)	August 22 index (Prov.)	Inflation rate (%)
Pan, tobacco and intoxicants	190.2	193.7	1.84

Table 11 The Consumer Price Index of the pan, tobacco, and intoxicants across Urban India for Aug 2021 and Aug 2022[9]

Description	August 21 index (Final)	August 22 index (Prov.)	Inflation rate (%)
Pan, tobacco and intoxicants	196.1	198.7	1.33

Table 12 The Consumer Price Index of the pan, tobacco, and intoxicants across Urban and Rural India for August 2021 and August 2022[9]

Description	August 21 Index (Final)	August 22 Index (Prov.)	Inflation Rate (%)
Pan, tobacco and intoxicants	191.8	195.0	1.67

corporate giants who control the industry and those who produce raw materials for it (Tables 10, 11 and 12).

The value of cigarettes involved in smuggling seized in this country came to $ 114,542,549. As of December 11, 2022, the amount of smuggled cigarettes seized in India had risen by 15,763,731, a stunningly sharp increase over last year. According to this estimate, in 2022, India will surpass $ 12,211,182 in this respect. The average price of three areas—alcoholic drinks, cigarettes, and pan was 195.0 in August 2022, rising by 1.67% since 2012. It should be noted that rural areas saw a much higher inflation rate, at 1.84% than the national average of 1.33% in town. This gap underlines the 'doer-push' (in action and afterwards) from the tobacco fields in the outlying countryside to big cities and their suburbs. A case in point is that most cigarette manufacturing happens in towns. However, in 2021, businesses were shut down in India because of the COVID-19 pandemic. Within rural areas, illicit cigarettes went on even during a pandemic. This pattern also indicates that counterfeit cigarettes are always sold in India's hinterlands. That is no less true of illegal tobacco. Domestic brands may be exercising tax evasion and marketing in rural India.

[11] MOSPI. (2022). *Consumer price index numbers on base 2012=100*. https://mospi.gov.in/documents/213904/416359//CPI%20Press%20Release%20Aug%2020221662984023598.pdf.

Solution and Recommendation

One must map out an overall strategy to tackle the tortuous challenges facing India's tobacco industry. Even if the strategy includes de-addiction centres establishment, healthcare personnel still need to be trained in gender-specific problems of addiction. Overpassing public awareness campaigns, psychoeducation is indispensable in countryside regions;

India and China must teach the population about the danger smoking poses to human health by using their languages and suitable forms of expression. Globally, awareness about the ill effects of tobacco should be emphasized. Helping farmers adopt new agricultural production patterns calls for incentives in the form of finance, technology transfer, and markets for alternative crops so that the transition is smooth and worthy of reliance. Enforcement of strict regulations combined with taxes on tobacco products may reduce their availability and consumption, with tax revenues funding public health projects and aid programs for smokers. However, for India, it is essential to remember that cheaper versions of tobacco products and alternatives are available.

Alcoholics control, diagnosis of overuse of alcohol, or drink and drive diagnosis could be possible to apply AI and machine learning and build advanced devices. There could be a need for investment in artificial intelligence-based applications and tools. Rebuilding Tobacco Control must adopt comprehensive national health principles, including prevention, early diagnosis and treatment of tobacco-related diseases. Such a national health policy must prioritize tobacco control and match it with adequate funding. Piomic cultures will be brought together into a balanced development pattern only by gentle practices comprising development and improvement of provinces. Building regional infrastructure, separating research plants from work facilities, and enabling individuals while ridding the country of illegal tobacco activities demands rigorous legal action and international cooperation; it also requires the enhancement of frontier defence measures as well as appropriate punishment for such illegal deals of tobacco and other illegal drugs.

Promoting eco-friendly and beneficial crops can replace the cigarette manufacturing industry through sustained agriculture, such as removing tobacco from the lifestyle, which is assisted by subsidies and support for alternative crops such as fruit, vegetables, and medicinal plants. Allocating financial resources to sustainable farming methods and non-tobacco-related ways of making a living by funding such as grants and cheap loans will provide continued support for farmers and entrepreneurs in developing sustainable businesses. If India follows these advice and suggestions, smoking-related health hazards and concerns may be solved. The tobacco industry can help support affected populations, and a healthier future for all country residents lies ahead.

Discussion

The Indian tobacco industry presents a complex array of challenges. A multifaceted and comprehensive strategy will be necessary to solve these problems. Central to this strategy is the establishment of de-addiction centres. Both men and women in addiction treatment have unique needs that underscore the importance of specially tailored care. Training healthcare professionals to deal with gender-specific issues in these centres can significantly increase the program's effectiveness. Awareness campaigns in rural areas are of crucial importance to the education of the population about the health risks that tobacco use brings. The success of these campaigns depends on using local dialects and materials with culturally interpretable content so that rural communities can receive the message in their language.

Such targeted communication helps people to make better decisions and reduces smoking. Another critical component is turning tobacco farmers into other crops and sustainable farming practices. Financial incentives, technical training, and market access are all necessary to make this transition work and allow farmers to earn sustainable incomes. It benefits the farmers to make this switch and helps sustain nature's resources and public health. String regulations and high tobacco product taxes are needed to curb supply and consumption. However, it has to be kept in mind that there are cheaper alternatives available in India, and there is an existence of illegal tobacco in India.

Nonetheless, they need to be enforced, with the revenues from taxes directed toward public health programs and support initiatives. Such a policy effectively deters smoking while the revenues fund essential health needs. Integrating AI and machine learning into addiction care marks a forward-thinking way of adapting and improving care. The technologies can provide tailored support and constantly monitor, widening the application and effectiveness of treatment. Investing in AI-based applications and tools is critical to exploiting this potential.

We must work in a comprehensive, all-around manner when making health policies for a country, with the priority always being tobacco control. Such a policy must include provision for prevention, early diagnosis, and treatment of tobacco-related diseases. Measures should also be taken to provide adequate funds for the Policy and supervise its implementation. In this way, it enables a structural approach to coping with the health dangers arising from tobacco use. Twenty first century needs appropriate tools for assessment and new tools for diagnosis; assessment has to be developed, which may be global by nature or culture-sensitive.

Popular support for developing practices that bridge the life standards in the city from those in the countryside has brought about a more equitable supply of resources and opportunities. Access to quality education, healthcare services, and on-the-spot infrastructure improvements are crucial in achieving balanced shared prosperity, reducing socioeconomic gaps, and bringing people out of poverty. With the existence of AI and ML, there are further possibilities to reduce the gap, cut down costs, and bring well-being. There is room to develop new interventional manuals

and new interventions to cut down addiction, or in fact, there is a possibility of understanding the underlying cause of addiction with the advances of technology.

Against the menace of the illegal tobacco trade, we must take the laws enforcement bodies have developed international joint measures to tackle the issue. In this battle, steps such as tightening borders, increasing penalties for smuggling and cooperating with overseas law enforcement institutions have become essential means for constraining and eliminating these gangs. With this approach, the availability of illegal-market tobacco products falls; public health is protected.

Sustainable developing agriculture through encouraging the cultivation of ecologically friendly, beneficial plants will tremendously affect the environment and human health. Tobacco cultivation can be replaced with subsidies and support extended to alternative crops such as fruits, vegetables and medicinal plants. This will help to create a healthier, more sustainable agricultural environment.

Finally, we must allocate financial resources to promote non-tobacco-based economic activities and sustainable agriculture. Government funding and low-interest loans provide agriculture businesses that can help develop the family's economic status and the area's economy.

The improvement of India's analogine industry requires an all-round approach. By implementing the solutions and suggestions discussed above, India can implement an all-around program to curb tobacco consumption, help communities, and facilitate sustainable development.

Conclusion

Rectifying the Indian tobacco industry's complex challenges will require a comprehensive strategy. Establishing gender-sensitive de-addiction centres, integrating public awareness in rural regions, psychoeducation and helping farmers move on to new agricultural production methods must be urgently done. Despite heavy taxation aimed at tobacco smoking, the rate of the tobacco market in India is still increasing. By using AI and ML, integrating technical means into mindfulness techniques may advance the healthcare position of the country. Inclusive development practices and dealing with illegal trade in a substance essential to imported food production are good for the environment and human beings, benefiting both the environment and sustainability. The tobacco industry needs to promote multi-cropping facilities for farmers. That way, farmers will have sustainable incomes and no difference in living standards between rural and urban areas. In the twenty-first century, many changes and revolutions have occurred; there are possibilities to develop new interventions, new psychoeducation, new intervention manuals, new interventions, and new assessment tools. There is a need to reduce tobacco consumption and address underlying causes. There are ample opportunities to apply mindful techniques, new assessment tools, new interventional manuals, new interventions, psychoeducation, awareness programs and correct strategies away from the traditional theories on an economic

programme that can sustain and alter tobacco consumption while improving public health.

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Investigating the Demand for Electric Two-Wheelers (E2Ws) Among the Indian Youth for a Journey Towards Sustainable Future

Satabdee Banerjee

Abstract The Government of India has targeted for a minimum 30% of the first-hand automobile sales to be electric by 2030 and 'Zero Emission' by 2070. Contextually, the present study aspires to make a prediction about the probability of a young resident of West Bengal, India, choosing to buy an electric two-wheeler (E2W), while identifying the factors behind such choice. Responses could be obtained from 413 young adults of West Bengal, belonging to the age-group of 18–41, using a questionnaire circulated through snowball sampling technique. Multinomial Logistic Regression (MLR) model is applied, followed by Chi-Square test. About 30% of the respondents opted for E2Ws among whom female students and employees, having an annual family income greater than INR 1,20,000 were found to have the highest probability of choosing an E2W. The daily distance to be commuted, number of persons commuting and the perceived benefits of E2Ws were the factors contributing towards the choice. The study endeavours to guide the manufacturers in understanding the volume of production required to meet the demand for E2Ws, the marketers to appreciate the expectations of the prospective customers, and the policymakers in subsequent E2W policy formulations for developing strategies towards faster adoption of E2Ws in India.

Keywords Electric Two-wheelers (E2W) · Probability · Multinomial Logistic Regression (MLR) · Chi-Square test · Sustainability

Introduction

Arctic to Antarctic melting of the glaciers submerging the coastal plains and changing the weather patterns, acute water crisis, deluge and droughts afflicting millions of lives, unprecedented wildfires and blistering heatwaves incapacitating the people,

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and prolonged extreme weather conditions across the world are indicators of acceleration of the apprehended advent of the global climate catastrophe. Despite decades of warnings from the United Nation's Climate Panel, energy-induced global carbon dioxide emission has reached a new record at 36.3 billion tonnes in 2021, the highest level in human history (Hunziker, 2022). Automobile emission which is one of the major causes of urban air and noise pollution is consistently leading to long term damages in the respiratory and auditory systems of the citizens along with causing irreversible long run damages to the environment and ecology. Coerced by deepened environmental trepidations and the need to control the escalating dependence on non-renewable and depleting fossil fuels, the mobility landscape across the world is about to undertake a paradigm shift. Electric and hybrid vehicles are gaining prominence as a potential replacement of the existing fossil-fuel driven automobiles to lead to zero-carbon emissions. The Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) clearly underlines the urgency of adopting sustainable transport systems to enable Climate Resilient Development as one of the means to combat and postpone the approaching apocalypse (IPCC, 2022).

According to the Global Electric Vehicle Outlook 2022 report, global sales of electric vehicles (EV) has reached a record high at 6.6 million in 2021 accounting for almost 10% of the global automobile sales. Market Research Future report (2020) projected the worth of the EV market at USD 957.42 billion by 2030, growing at a Compounded Annual Growth Rate (CAGR) of 24.51% during the period 2022–2030. Half of the EV sale in 2021 (3.3 million) took place in China (International Energy Agency, 2022) due to the favourable government policies, incentives and infrastructural boost to support and promote EV sales (International Council on Clean Transportation, 2017). The other emerging and developing nations are lagging far behind in comparison to China as only 0.5% of the total car sale in India, Indonesia and Brazil are in the EV segment.

Two-wheelers segment constitutes 80.8% of the Indian automobile industry (India Brand Equity Foundation, 2021). Electric two-wheeler (E2W) sale has increased almost 63%in India during the first quarter of 2022, Maharashtra taking the lead followed by Karnataka and Gujarat (EVReporter, 2022). Hero Electric is the market leader in E2W segment with 36% market share, trailed by Okinawa (21%) and Ather Energy (11.1%) (India Brand Equity Foundation, 2022). The Government of India imposed several environmental regulations like the introduction of Bharat Stage VI automobile emission norms, Compressed Natural Gas (CNG) and hydrogen fuelled automobiles, fleets of electric buses and commercial vehicles, the Faster Adoption and Manufacturing of Hybrid and Electric Vehicle (FAME) subsidy scheme and Production-Linked Incentive (PLI) Scheme to promote cleaner transport through the adoption of electric and hybrid vehicles across India. Ride-sharing, running of odd and even cars on alternate days, and more initiatives in similar lines were also being encouraged, when it came to COVID 19 pandemic and its consequent lockdowns. This necessitated the maintenance of physical distancing leading to an upsurge in demand for personal vehicles. Post-lockdown, soaring fuel prices along with incessant deterioration of environment and ecology aggravated the gravity of the situation (Banerjee, 2022).

Various incentives are on offer by the Government of India for popularising E2W-adoption (Table 1).

Nonetheless, India has way to go unlike United Kingdom, Germany, Norway and Singapore, who have pledged to go electric by 2025–2040 (He et al., 2022). Parallel to the promotional schemes, numerous researches are also being undertaken to give cognizance to the different aspects of EV usage as a sustainable alternative to traditional automobiles encompassing discussions on Lifecycle cost–benefit analysis of EVs (Karabasoglu & Michalek, 2013;Weiss et al., 2015; Malmgren, 2016; Mitropoulos et al., 2017; Edwards, 2020; Qiao et al., 2020), its demand and supply aspects (Weinert et al., 2008; Cherry & Jones, 2009; Weerasiri & Mendis, 2015; Somireddy, 2018; Thapa, 2021; Li et al., 2021; Banerjee, 2022; Patil & Majumdar, 2022), how environmental concerns are acting as motivators behind EV adoption decision (Cherry & Jones, 2009; Nansai et al., 2002; Scorrano & Rotaris, 2022), and infrastructure and policy aspects of EV adoption (García & Jeffrey, 2017; Straka et al., 2020; He et al., 2022). Such deliberations focus on aspects like EV variations, components, configurations, possible energy sources, charging infrastructure and technologies (Un-Noor et al., 2017). However, no specific endeavour to predict the choice of a prospective customer of a two-wheeler depending on their demographics has been attempted so far to successfully address the demand and supply mismatch of E2Ws in India. Consequently, the present study endeavours firstly, to predict whether a young resident of West Bengal, India would choose to buy either an ICE two-wheeler, or an E2W, or neither of them, on the basis of certain demographic factors and secondly, to identify the factors influencing their E2W purchase decision.

Table 1 Government of India incentive schemes

FAME II department of heavy industries	Department of goods and services tax	Income tax department	Ministry of road transport & highways (MoRTH)
A subsidy of INR 15,000 per kwh of battery capacity (maximum up to 40% of the cost of the vehicle)	EVs are subjected to a lower GST rate of 5%	Under section 80 EEB of the Income Tax Act, the first time buyers can get a deduction up to INR 1,50,000 on the interest on loan taken for purchasing an EV	Waiver of fees for fresh issue or renewal of registration certificates of E2Ws

Source Banerjee (2022)

Literature Review

Lifecycle Cost–Benefit Analysis

A number of research papers have been written to shed light on the Life Cycle Costing (LCC) perspectives of E2Ws (Karabasoglu & Michalek, 2013; Edwards, 2020). However, reflection of the true value of EVs to society demands incorporating its benefits to human health, environment and economic growth (Malmgren, 2016). Mitropoulos et al. (2017) found that the total cost of EV ownership surpassed the low cost of EV externalities. The study of Qiao and et al. (2020) too established that the life-cycle cost of an EV is 9% higher as compared to their ICE counterparts. Simultaneously, the life-cycle GHG emissions of an ICE vehicle was assessed to be 29% higher than the EVs in Beijing making EVs attractive for environmental causes. Weiss et al. (2015) observed that E2Ws constituted niche products in the European market. Facilitation of large-scale EV adoption for traffic noise and road congestion reduction required urban infrastructure development and imposition of road safety regulations in Europe.

Demand and Supply Aspects

Price of the two-wheelers, two-wheeler brands, model, advertisements, availability of spare parts, after sales services, technology and design, offer and schemes, economic purposes and mileage, has been found to influence the buying behaviour of consumers while making an ICE two-wheeler purchase decision (Somireddy, 2018; Thapa, 2021; Weerasiri & Mendis, 2015). Few studies specific to E2W buying behaviour can also be identified from the available literatures. Patil and Majumdar (2022), in their endeavour to find out the key factors impacting the usage of two-wheelers in Urban India applied Multi-Criteria-Decision-Making (MCDM) techniques and suggested that economy-related attributes, vehicle built-related attributes, perceived benefits-related attributes and and transport infrastructure-related attributes tend to attract the Indian prospective customers. Among these, aspects like low price, longer range, higher speed and faster acceleration draw greater attention as compared to the other factors. Fuel prices, price of ICE two-wheelers as a regular and available substitute, taxes and licensing policies were also found to be some of the other significant attributes impacting favourable E2W purchase decision (Weinert et al., 2008; Cherry & Jones, 2009; Banerjee, 2022). Li and et al.(2021) observed that in the first-tier cities of China, government subsidies and environmental policies act in favour of EVs, while purchase and driving restrictions act as a detriment to the popularity of the ICE vehicles.

Environmental Concerns

Scorrano and Rotaris (2022) observed that environmental concern at the local level in the city of Trieste, Italy posed as a significant favourable factor along with the attributes stated in the earlier section. Cherry and Jones (2009) made a comparative study of the environmental impacts of E2W adoption in the Indian city of Ahmedabad and in the Vietnamese city of Ha Noi. It was found that E2Ws on Indian roads cause greater indirect GHG emissions as the electricity used for charging the E2Ws in India are mostly generated by burning coal. Moreover, higher rates of energy loss during transmission of such electricity in India is another factor behind greater indirect GHG emissions of the E2Ws. In contrast, Vietnam relies more on natural gas-based power plants which cause lesser GHG emissions. Nonetheless, E2W adoption has the potential to improve the air quality of both the cities by dint of lesser direct GHG emissions through tailpipe emissions. Nansai and et al.(2002) undertook a lifecycle inventory analysis of a retrofitted EV from a small gasoline-powered vehicle. They found that regional differences of the primary energy mix of electricity generation was found to significantly influence the EV emissions in Japan.

Infrastructure and Policy Aspects

Availability of charging infrastructure poses as a significant decisive factor in large scale adoption of EVs, absence of which leads to range anxiety among the users. In their endeavour to scale up EV charging on an industrial basis García and Jeffrey (2017) developed a cost-effective and eco-friendly design of a solar charging station at a farm of Edinburgh College of Scotland, United Kingdom, which proved to be both technologically and economically feasible. Straka et al. (2020) in their study proposed a predictive model for identifying possible popular charging station locations for formulating infrastructure deployment strategies, while He et al.(2022) suggested spatial planning and deployment strategies for public electric vehicle charging infrastucture in high-density cities like Hongkong. Installation of solar PV modules on top of the parking spaces have already become a practice in many advanced countries. Such provisions can be parallely availed as an EV charging infrastructure. In case of developing countries, due to cost constraints, opening and operating privately-owned solar-powered fast charging stations in the model of Public Call Offices (PCObooths) besides the roads, highways and parking spaces can ensure quick, hassle-free, low-cost and eco-friendly charging options instead and thereby can supplement the planned Government and corporate-owned charging stations (Banerjee, 2022).

Development and disposal of batteries are important considerations in EV adoption. There is a concern about the environmental degradation by way of soil and water pollution caused by irresponsible disposal of acids, lead and other toxins present in the batteries. According to Sanguesa et al. (2021) recyclable, high capacity batteries

and wireless charging technologies can facilitate this process. Initiatives are being taken to introduce battery-swapping facilities in many parts of the world.

Poor road and traffic conditions act as a detriment to improving local air quality. It can cause deterioration in performance of a vehicle as well. Majumdar et al. (2016), using experimental and survey results, analysed the performance of E2W on the basis of their running conditions in the traffic situation of Kolkata, the capital city of West Bengal, India.

Data and Methodology

Data

A structured questionnaire, framed using a Google Form, was circulated among the young residents of West Bengal, India, who were aged between 18 to 41, for primary data collection between August 2021 and February 2022. 413 complete responses could be collected for the study by the application of non-probabilistic snowball sampling technique.

Methodology

In this study, the dependent variable is a categorical variable with more than two categories, hence, the Multinomial Logistic Regression (MLR) model is applied. Odds ratio, which is the ratio between the probabilities of the happening of an event with the probability of the event not happening is calculated. There are three possible decisions any of which might be taken by the young residents of West Bengal:

(a) buying an ICE two-wheeler, or
(b) purchasing an E2W and
(c) not buying any two-wheeler at all.

The predictions about E2W purchase decision were based primarily on demographic factors such as age, gender, occupation, annual family income and locality of residence. The respondents were segregated into three age groups of 18–25, 26–33 and 34–41. Their genders were subdivided into three groups of male, female and others (none of the respondents belonged to this category). Their occupations were categorized as student, government service, private sector job, business, self-employed, homemaker and others (business, self-employed, homemaker and others were subsequently clubbed under the head "others" due to limited responses in these categories). The annual family income of the respondents were subdivided into five categories, income less than INR 1,20,000; income ranging from INR 1,20,000 to less than INR 5,00,000; income ranging from INR 5,00,000 to less than INR 10,00,000;

income ranging from INR 10,00,000 to less than INR 20,00,000; and income greater than INR 20,00,000 (however, the last two categories were clubbed under the head "income greater than INR 10,00,000" due to limited responses in these two categories). And finally the locality of residence was subdivided into three groups of urban, semi-urban and rural area.

This first segment of the study encapsulates multiple cross-tabular formats for scrutinizing the existence of any association between the chosen variables. If any such association is found, the strength of such association between the selected variables is tested through the application of Chi-square test and Cramer's V test.

An MLR model is a modification of the logistic regression model where the response variables are explained in terms of odds ratio, measuring the association between the response and the explanatory variables. Suppose in this study, we have n independent observations of p independent variables, and there are k categories for the qualitative dependent variable. One of these k categories has to be considered as the base category relative to which the multinomial logits would be constructed. When intended to find the relationship between the probabilities of p independent variables, for an observation falling in the jth (k–1) category, the multinomial logit model would be as:

$$\log\left[\frac{\pi_j(x_i)}{\pi_k(x_i)}\right] = \propto_{0i} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \ldots + \beta_{pj}x_{pi} \tag{1}$$

where, j = 1, 2, ….., (k–1) and

i = 1, 2, ……, n

$\pi(x) = p(Y = 1|X = x) = 1 - p(Y = 0|X = x)$, or

$\pi(x) = \frac{\exp(\alpha+\beta_1 x_1+\cdots+\beta_k x_k)}{1+\exp(\alpha+\beta_1 x_1+\cdots+\beta_k x_k)}$ and

β_i = The effect of x_i on the log odds that the dependent variable (Y) is equal to 1, other

x_j remaining constant, alternatively stated,

exp (β_i) = the multiplicative effect on the odds of a unit increase in x_i, other x_j

remaining constant

Since, $\sum_j^0 \pi_j(x) = 1$, the equation can be represented and the model estimated as follows:

$$\log(\pi_j(x_i)) = \frac{\exp(\propto_{0i} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \ldots + \beta_{pj}x_{pi})}{1 + \sum_{j=1}^{k-1}\exp(\propto_{0i} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \ldots + \beta_{pj}x_{pi})} \tag{2}$$

El-Habil (2012).

In the second segment of the study, the responses of the respondents who opted to purchase E2W were further tabulated on the basis of the distance to be commuted, number of persons commuting and the perceived benefits of the E2Ws. The strength

of such association between the selected variables was tested through the application of the Chi-square test.

Findings and Analysis

Table 2 summarizes the number of responses along with their frequency distributions against each of the questions asked. It revealed that majority of the respondents (53.5%) neither owns, nor is planning to purchase any form of two-wheeler, whether ICE or electric. Among the remaining respondents, 30.8% either have or would prefer buying an E2W, whereas only 15.7% either owns or is intending to buy an ICE two-wheeler.

A Chi-square test was thereafter conducted to find out which demographic factors are associated with the respective choices of the respondents, as captured in Table 3.

The findings suggest that the choices of the respondents regarding purchase of two-wheelers are associated with their

i. gender,
ii. occupation and
iii. annual family income.

However, the values of both the Contingency Coefficient and Cramer's V are quite low for all the cases implying that the strength of association between the choice of the respondents and the selected response variables is not very high.

The null hypotheses of the Chi-Square test of the existence of no association between the choice of two-wheeler purchase and age, as well as locality of residence failed to be rejected, and hence no association between them can be claimed. Thus, the response variables 'Age' and 'Locality of Residence' have not been considered for further analysis in the modelling.

Table 4 has been extracted from a larger table comprising of all the response variables as well as explanatory variables. The marginal percentage column displays the percentage of the respective choices of the respondents. Each subpopulation involves a unique combination of explanatory variables specified in the model. In this case, there are 29 such combinations. Out of them, 4 (13.8%) subpopulations have only one observed value of the dependent variable.

Therefore, the proportional by chance accuracy rate (the sum of squares of proportions) can be calculated to be $(0.308^2 + 0.157^2 + 0.535^2) = 0.405738 = 40.6\%$. Hence, the benchmark criteria for the proportional by chance accuracy rate would be $1.25 * 0.405738 = 50.7\%$ (El-Habil, 2012).

In the next stage, the value of standard errors of more than 2 in the parameter estimates table is sought after. However, no such value could be obtained, signifying that the model would not produce any spurious outcomes (El-Habil, 2012).

It is observed from Table 5 that the intercepts of both the dependent variables, and of few more cases, are not statistically significant and have failed to satisfy the required condition. Further diagnostic tests reveals the following:

Table 2 Frequency distribution of the responses (n = 413)

Characteristics	Frequency (n)	Percentage (%)
Choice		
EV	127	30.8
ICE	65	15.7
None	221	53.5
Age		
18–25 26–33 34–41	250 74 89	60.5 17.9 21.6
Gender		
Male	209	50.6
Female	204	49.4
Others	0	0.0
Occupation		
Student	243	58.8
Government service	55	13.3
Private sector job	74	17.9
Business	6	1.5
Self-employed	14	3.4
Homemaker	10	2.4
Others	11	2.7
Annual Family Income		
Less than INR 1,20,000	140	33.9
INR 1,20,000 to less than INR 5,00,000	109	26.4
INR 5,00,000 to less than INR 10,00,000	90	21.8
INR 10,00,000 to less than INR 20,00,000	44	10.7
More than INR 20,00,000	30	7.2
Locality of Residence		
Urban	302	73.1
Semi-urban	59	14.3
Rural	52	12.6

Source Author's calculations

The Classification Table 6 of the selected model shows that the computed overall percentage of 55% is greater than the proportional by chance accuracy rate of 50.7%, as calculated earlier from Table 4. Hence, the classification accuracy criteria is satisfied. The Pseudo R-Square statistic (not reported) indicates that the model parameters are within the acceptable limits. Further, the -2 Log Likelihood Criteria (not reported) also proves that the model is a well fitted one, as the Chi-Square value is significant at 1% level, rejecting the null hypothesis of no difference between the model with

Table 3 Association between Choice of two-wheelers and selected independent variables

Preference of learning mode dependent on ↓	Pearson's Chi-square value**	df	p	Contingency coefficient	Cramer's V
Age	6.913	4	0.141	–	–
Gender	12.496	2	0.002*	0.171	0.174
Occupation	19.354	6	0.004*	0.212	0.153
Annual family income	16.146	6	0.013*	0.194	0.140
Locality of Residence	7.375	4	0.117	–	–

* Significant at 1% level
** Cells have expected value more than 5
Source Author's calculations

Table 4 Case processing summary for the calculation of by chance accuracy rate

Preference	N	Marginal percentage (%)
EV	127	30.8
ICE	65	15.7
None	221	53.5
Valid	413	100
Missing	0	
Total	413	
Subpopulation	29[a]	

[a]The dependent variable has only one value observed in 4 (13.8%) subpopulations.
Source Author's calculations

independent variables and the model without independent variables. Thus, the existence of a relationship among the dependent and independent variables is sustained. Hence, only the significant results from Table 5 are considered for further analysis.

The column "Exp(B)" of Table 5 shows the odds ratio of the independent variables with the dependent variable. An odds ratio greater than 1 indicates an increase in the dependent variable, and an odds ratio less than 1 indicates a decrease in the dependent variable, as in case of all the selected cases; while an odds ratio close to 1 indicate non-responsiveness.

In this model 'None', i.e. respondents deciding not to buy any two-wheeler, have been placed as the baseline category denoted by π_0 and its estimate by $\widehat{\pi}_0$; EV is represented by π_1 and its estimate by $\widehat{\pi}_1$ and ICE is symbolised by π_2 and its estimate by $\widehat{\pi}_2$. Therefore, from the parameter estimates of Table 10 the respective probabilities can be computed as follows:

Firstly, as there are three categories (J = 3) of the dependent variable, the following two equations can be obtained:

Table 5 Parameter estimates table

Own/ plan to purchase a two-wheeler[a]		B	Std. error	Wald	df	Sig	Exp(B)
EV	Intercept	0.030	0.348	0.007	1	0.932	
	Gender = Female	−0.499	0.239	4.338	1	0.037	0.607
	Gender = Male	0[b]			0		
	Occupation = Government Service	0.384	0.399	0.926	1	0.336	1.468
	Occupation = Others	−0.985	0.480	4.218	1	0.040	0.373
	Occupation = Private Sector Job	0.251	0.349	0.518	1	0.472	1.286
	Occupation = Student	0[b]			0		
	Annual family income = Less than Rs 1,20,000	−0.699	0.372	3.520	1	0.061	0.497
	Annual family income = More than Rs 10,00,000	−0.108	0.368	0.086	1	0.769	0.898
	Annual family income = Rs 1,20,000 to less than Rs 5,00,000	−0.365	0.361	1.024	1	0.311	0.694
	Annual family income = Rs 5,00,000 to less than Rs 10,00,000	0[b]			0		
ICE	Intercept	−0.105	0.398	0.069	1	0.792	
	Gender = Female	−0.769	0.307	6.291	1	0.012	0.463
	Gender = Male	0[b]			0		
	Occupation = Government Service	−0.677	0.536	1.598	1	0.206	0.508
	Occupation = Others	−1.19	0.597	3.993	1	0.046	0.304
	Occupation = Private Sector Job	−0.241	0.420	0.330	1	0.565	0.786
	Occupation = Student	0[b]			0		
	Annual family income = Less than Rs 1,20,000	−1.34	0.463	8.311	1	0.004	0.263

(continued)

Table 5 (continued)

Own/ plan to purchase a two-wheeler[a]		B	Std. error	Wald	df	Sig	Exp(B)
	Annual family income = More than Rs 10,00,000	−0.317	0.475	0.446	1	0.504	0.728
	Annual family income = Rs 1,20,000 to less than Rs 5,00,000	−0.179	0.418	0.184	1	0.668	0.836
	Annual family income = Rs 5,00,000 to less than Rs 10,00,000	0[b]			0		

[a] The reference category is none
[b] This parameter is set to zero as it is redundant
Source Author's calculations

Table 6 Classification table of the model

Observed	Predicted			
	EV	ICE	None	Percent correct
EV	37	0	90	29.1%
ICE	16	0	49	0%
None	31	0	190	86%
Overall Percentage	20.3%	0.0%	79.7%	55%

Source Author's calculations

$$y_1 = log\left(\frac{\widehat{\pi}_1}{\widehat{\pi}_0}\right)^0 \tag{3}$$

and

$$y_2 = log\left(\frac{\widehat{\pi}_2}{\widehat{\pi}_0}\right)^0 \tag{4}$$

Therefore, $= y_1 = log\left(\frac{\widehat{\pi}_1}{\widehat{\pi}_0}\right)^0$

$= -0.499$(Gender = Female)—0.985 (Occupation = Others)—0.699 (Annual family income = Less than INR 1,20,000).

And $y_2 = log\left(\frac{\widehat{\pi}_2}{\widehat{\pi}_0}\right)^0 =$

$= -0.769$ (Gender = Female)—1.19 (Occupation = Others)—1.34 (Annual family income = Less than INR 1,20,000).

The rest of the categories of the independent variables cannot be included in the equations as they are not found to be statistically significant at 5% or 10% level of significance.

Secondly, $\widehat{\pi}_0, \widehat{\pi}_1and\widehat{\pi}_2$ are computed where e or exp = 2.71828 is the base of the natural logarithmic system.

$$\widehat{\pi}_0 = \frac{1}{1 + \exp(y_1) + \exp(y_2)} \tag{5}$$

$$\widehat{\pi}_1 = \frac{\exp(y_1)}{1 + \exp(y_1) + \exp(y_2)} \tag{6}$$

$$\widehat{\pi}_2 = \frac{\exp(y_2)}{1 + \exp(y_1) + \exp(y_2)} \tag{7}$$

The prediction of the model is based upon classifying the possible combinations in one of the three groups of the dependent variables. However, corresponding statements about most of the categories of the independent variables cannot be made as the odds ratios of those independent variables were not found to be statistically significant. The model comprises of two equations to estimate the three response probabilities (π_0, π_1, π_2) by the application of equations

$$y_1 = log\left(\frac{\widehat{\pi}_1}{\widehat{\pi}_0}\right)^0 = -0.499 - 0.985 - 0.699 = -2.183$$

And $.y_2 = log\left(\frac{\widehat{\pi}_2}{\widehat{\pi}_0}\right)^0 = -0.769 - 1.19 - 1.34 = -3.299$

Hence, by using the above equations, the estimated probability of occurrence of some of the possibilities can be estimated as follows:

Case 1: When a new respondent comes who is a lady, whose occupation is categorised as 'Others' and whose annual family income is less than or equal to INR 1,20,000:

$$\widehat{\pi}_1 = \frac{\exp(-2.183)}{1 + \exp(-2.183) + \exp(-3.299)} = 0.0980$$

$$\widehat{\pi}_2 = \frac{\exp(-3.299)}{1 + \exp(-2.183) + \exp(-3.299)} = 0.0321$$

$$\widehat{\pi}_0 = \frac{1}{1 + \exp(-2.183) + \exp(-3.299)} = 0.8699$$

There is a probability of 0.098 that the lady would chose to buy an E2W, a probability of 0.0321 that she would choose to buy an ICE2W and a probability of 0.8699 that she would choose not to buy any two wheeler at all.

Table 7 encapsulates the probabilities of all such possible cases as follows:

Table 7 Probability Table

Choice	Female				Male			
	Income ≤ INR1,20,000		Income > INR1,20,000		Income ≤ INR1,20,000		Income > INR1,20,000	
	Occupation = Others	Occupation ≠ Others	Occupation = Others	Occupation ≠ Others	Occupation = Others	Occupation ≠ Others	Occupation = Others	Occupation ≠ Others
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
EV ($\widehat{\pi}_1$)	0.0980	0.2121	0.1658	0.2933	0.1467	0.2826	0.2226	–
ICE ($\widehat{\pi}_2$)	0.0321	0.0852	0.1031	0.2238	0.0630	0.1489	0.1813	–
None ($\widehat{\pi}_0$)	0.8699	0.7027	0.7311	0.4829	0.7903	0.5685	0.5961	–

Source Author's calculations

Case 3: There is a probability of a meagre 0.1658 that a lady respondent whose occupation is categorised as 'Others', having annual family income more than INR 1,20,000, would chose to buy an E2W, and a probability of 0.7311 that she would not buy any two-wheeler.

Case 5: There is a probability of only 0.1467 that a male respondent whose occupation is categorised as 'Others', having annual family income less than INR 1,20,000, would chose to buy an E2W.

Case 7: There is a probability of 0.5961 that a male respondent whose occupation is categorised as 'Others', having annual family income more than INR 1,20,000, would not choose to buy any two wheeler at all and a probability of 0.2226 that he would choose to buy an E2W.

Case 8: The probabilities in this case cannot be defined in absence of significant intercept values.

It is worthy to note that in all the possibilities, the probabilities of buying an ICE2W is lesser than that of an E2W signifying that if at all a respondent chooses to buy a two-wheeler, (s)he would prefer an E2W over an ICE2W.

Finally, an attempt was made to find out the factors influencing E2W purchase decision along with the strength of such association.

Though 127 out of the 413 respondents responded in favour of E2W purchase, the responses of only 120 respondents could be considered for study in Table 8 due to incomplete responses from 7 respondents. The null of no difference for a Chi-square test was rejected for all the three cases namely, purpose of use, number of commuters and perceived benefits of E2W usage signifying that all these variables were significant in taking decision in favour of E2Wpurchase. Most of the respondents favoured E2Ws for short distance daily commute (65%) while mostly travelling single (80%). Eco-friendliness is the biggest advantage of E2W use according to most of them (45%) (Qiao et al., 2020).

Conclusion and Recommendations

The Government of India is targeting for a minimum 30% of the first-hand automobile sales to be electric by 2030 by supporting the EV30@30campaign, and spearheaded by NITI Aayog is ambitious to become 'Zero Emission' by 2070. These initiatives would help in simultaneous achievement of the Sustainable Development Goal (SDG) 11: Sustainable Cities and Communities, by dint of improving the air quality and reduction of noise caused by automobiles; SDG 12: Responsible Consumption and Production, by curbing down the reliance on imported fossil fuels and leaving lesser environmental footprints, as well as SDG 13: Climate Action, by adoption of a sustainable lifestyle.

Table 8 Frequency distribution of the responses in favour of purchasing E2Ws (n = 120)

Characteristics	Frequency (n)	Percentage (%)		
Purpose of use				
Short distance daily commute	78	65	$\chi 2$	63.95
Long distance daily commute	35	29.2	df	2
Occasional use	7	5.8	CV	5.991
Solo travel				
Mostly	96	80	$\chi 2$	117.65
Always	13	10.8	df	2
Never	11	9.2	CV	5.991
Perceived benefits				
Eco-friendliness	54	45	$\chi 2$	145.87
Combating the rise in fuel prices	24	20	df	7
EV is the future	17	14.2	CV	14.067
Physical distancing	12	10		
Others	7	5.8		
Price reduction due to introduction of FAME II subsidy	3	2.5		
Lesser maintenance required	2	1.7		
Introduction of new models	1	0.8		

Source Author's calculations

There is regional disparity in EV demand, supply and adoption across the Indian subcontinent. Along with the significant promotional schemes offered by the Government of India to incentivize E2W adoption (Table 1), few State Governments have also put on offer certain incentive schemes to popularize E2W adoption in their respective States as Table 9.

West Bengal has formulated a separate Electric Vehicle Policy with focus on research and EV infrastructure development. However, no additional demand incentives are on offer by the State Government to boost E2W demand through price reduction. Even the road tax exemption for EV, as part of a proposal of the MoRTH, is not yet in vogue. Only proportionate waiver for two years is on offer with not much practical benefits to the end users. New Town is the only Smart City of West Bengal where complete electrification of the public transport system is being targeted as part of a major pilot project. Few more demand incentives in line with the States like Maharashtra and Gujarat, if introduced by West Bengal Government, might have boosted the E2W demand in the state.

The role of publicity and sales promotion to create brand awareness and consequently, demand, is undeniable. Newer ICE models of popular two-wheeler brands and companies are still being introduced and advertised in huge scale and numbers.

Table 9 State-wise incentive schemes to promote E2W adoption in India

States	Electric Vehicle Policy	In excess of FAME II	Scrappage benefit of old ICE vehicle	Road tax waiver	Registration fees waiver	Other incentives
Maharashtra	√	INR 10,000/kwh	INR 7,000	100%	100%	INR 7,000 early bird incentive plus INR 12,000
Assam	√	INR 10,000/kwh (maximum INR 20,000)	–	100%	100%	100% parking fees waiver
Delhi	√	INR 5,000/kwh (maximum INR 30,000)	Up to INR 5,000	100%	100%	–
Gujarat	√	INR 10,000/kwh (maximum INR 20,000)	–	100%	100%	–
Rajasthan	√	INR 2,500/kwh (maximum INR 10,000)	–	–	–	Reimbursement of SGST and lumpsum grant
Meghalaya	√	INR 10,000/kwh (maximum INR 20,000)	–	100%	100%	–
Odisha	√	15% of cost (maximum INR 5,000)	–	100%	–	–
Telangana	√	Emphasis given on the research, and development of electric vehicle infrastructure		100%	100%	Charging points and reserved parking at metro stations and bus depots
Karnataka	√			100%	100%	–
Andhra Pradesh	√			100%	100%	–
Tamil Nadu	√			100%	100%	–
Uttar Pradesh	√			100%	100%	–
Kerala	√			100%	100%	–
Arunachal Pradesh	√			100%	100%	–
Madhya Pradesh	√			99%	99%	–

(continued)

Table 9 (continued)

States	Electric Vehicle Policy	In excess of FAME II	Scrappage benefit of old ICE vehicle	Road tax waiver	Registration fees waiver	Other incentives
West Bengal	√			Proportionate waiver for two years		–
Uttarakhand	√					

*Sourc*e Ahmed (2022), Banerjee (2022)

Banerjee (2022) found that 18% of her respondents had no idea about E2Ws and only 8% of them learnt about E2Ws through television, the most popular and widely circulated medium of communication in India. Introduction of a greater number of public transports and commercial e-vehicles run by the State Government might increase awareness and acceptance of EVs among the citizens of West Bengal, India.

The present study, though limited within the young adults of the Indian state of West Bengal, has the possibility of being extended further to other states or countries, or to the study of the demand of other forms of electric vehicles as well. It might guide the manufacturers in understanding the volume of production required to meet the future demand for E2Ws, and the marketers to identify and understand the expectations of the prospective customers for making E2Ws more popular and demanded. The study will also help in subsequent E2W policy formulations and developing marketing strategies for faster adoption of E2Ws.

With the multifaceted contrivances, it would not be long when India, in partial fulfilment of her collective global-warming mitigation commitment, will come up as a leader in E2W manufacturing and usage, causing zero tailpipe emissions, and advance in achievement of the SDGs. The world is in urgent need that a greater share of the global social wealth is spent on combating climate catastrophe through every possible means, instead of spending trillions of dollars on war. As put by the United Nations Secretary-General, that we have two options, either we take collective action, or we commit collective suicide, the choice is ours (Stancil, 2022).

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