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Editorial

Dear Reader,

Welcome to the June 2024 edition of Artha! The peer-reviewed e-Journal, published by the Finance Research and Trading Laboratory at IIM Calcutta, remains dedicated to showcasing insightful articles from both academics and industry professionals. With a primary focus on Accounting, Finance, and Governance, Artha strives to enhance understanding of recent advancements in these dynamic areas.

We extend our heartfelt appreciation to our readers for their support. The growing number of subscribers highlights the increasing impact and popularity of our publication. In this June 2024 issue, we are thrilled to feature four articles that cover a broad spectrum of topics within Accounting, Finance, and Governance. We trust that these contributions will engage your interest and provide valuable insights.

The first article ***"To Dream or Not to Dream?"*** discuss the impact and increased popularity of online games. The author emphasis that while the revenue of companies offering online games are increasing but the social impact may be seductive. Also rise of such platforms have a disproportionately on affects lower-income populations, who often view online gambling as a means of financial stability. The impact of online gambling, including its socio-economic costs and regulatory challenges, necessitates comprehensive policy measures to protect vulnerable populations.

The second article ***"Indian Corporates Capture Berths in Global ESG Assessment – Cases of Select Indian Companies"*** analyse the performance of select Indian companies on ESG dimensions, inspired by their inclusion in S&P Global's Sustainability Yearbook 2024, and to highlight the initiatives undertaken by these companies ESG space as assessed by S&P Global. The author discusses International and national frameworks, from the International Integrated Reporting Council (IIRC) and Securities and Exchange Board of India (SEBI), promoting ESG disclosure and practices.

The third article ***"Redefining Lending: Harnessing Financial Engineering in the Modern Era"*** discuss the application of new techniques, such as AIML leading to improved credit assessment, risk management and better customer experience. The author argues that use of alternative data, machine learning algorithms, and real-time analysis has improved credit scoring models and predictive analytics, making lending decisions more precise and timely. The article also discusses the future potential challenges and impact of financial engineering in transforming the financial industry.

The fourth article ***"Carbon Pricing and Carbon Markets"*** the author emphasizes the urgent need to reduce greenhouse gas emissions to mitigate climate change effects. The author explains the concept of carbon pricing as a tool to internalize the external costs of greenhouse gas emissions, promoting more efficient market outcomes and encouraging emission reductions. The article provides insights into the design elements and practical implementation of carbon pricing policies

We trust that you will find enjoyment in reading all the articles in this issue, and we extend our sincere gratitude to the authors for their valuable contributions. We invite you, our esteemed readers, to consider Artha as a platform for publishing your own articles. Feel free to send us your contributions and feedback at artha@iimcal.ac.in. We eagerly anticipate the continued support and engagement of our readers and contributors in the future.

Vivek Rajvanshi
Chief Editor

Contributors

Sushobhan Paul is a Research Scholar at Shiv Nadar University in Delhi, focusing on Finance. He holds a master's degree in economics from Jawaharlal Nehru University, New Delhi, and has two years of experience as an Associate Consultant in the corporate sector. His research interests include corporate finance, financial economics, and political finance.

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Utkarsh Majmudar is a professional with over two decades of experience encompassing teaching, research and administration at premier business schools in India (IIM Bangalore, IIM Lucknow, IIM Udaipur etc.) and working with large corporations in India at GE Capital, iGATE and HSBC. Apart from finance, he has done significant work in the area of sustainability – conducting an annual study of the performance of companies on corporate responsibility, working with large companies, publishing cases on sustainability, and writing extensively on the theme. He has co-authored two books. The second book, Shift: Decisions for a Net Zero World, was released recently. Utkarsh is a member of the Board of Governors at IIM Raipur. He is also on the editorial board of A₹tha.

To Dream or Not to Dream?

Sushobhan Paul[1]

"Sir, I desire to buy a car and have my cab service someday. Do you think Dream 11 is a good income source in that case?" ----- An ambitious, struggling cab driver in Delhi NCR.

Introduction

Online gambling, an ostensibly nascent phenomenon, has become a prevalent form of entertainment and recreation in today's digital age globally, as per the reports of the Gambling Commission[2], UK. With the rise of internet accessibility, individuals can now easily access various online gambling platforms and participate in a wide range of games such as poker, slots, and sports betting.

Sociologists have long recognized the allure of casino gambling and have described it as "seductive" in its ability to captivate participants. In the digital age, gambling has undergone a profound transformation with the rise of online platforms, making it more accessible than ever before. The proliferation of online casino games and the evolution of online gambling have generated new opportunities for both individuals and the industry. However, this shift has also brought to light a critical issue: the disproportionate impact of online gambling on lower-income populations. Research suggests that the lower-income demographic is particularly susceptible to the lure of online gambling, often viewing it as achieving a means of financial stability and social mobility that has eluded them through traditional avenues (Cotte & LaTour, 2009).

Lottery vs. Gambling

The lottery is an impulse, while betting and gambling are pre-planned activities[3]. For a lottery, one buys the ticket based on their lucky number and waits for the draw day to witness the outcome. Winners are selected purely on a random basis from the pool of participants. In gambling, the amount of money one can win is a functional outcome of the money the player has chosen to put in. According to legal definitions and various

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[2] Refer to https://www.gamblingcommission.gov.uk/statistics-and-research/publication/statistics-on-participation-and-problem-gambling-for-the-year-to-march-2022 , last accessed on 8th June 2024.
[3] Refer to https://www.kenyans.co.ke/news/major-differences-between-lottery-gambling-and-betting-18032 , last accessed on 31st May 2024.

associations that govern or directly delve into this business, lottery and gambling are two distinct games with separate attributes. As per the Lithuanian Lottery Association [4], by legal definition, a lottery is a game with predefined and established rules where participants engage by buying tickets for a chance to win cash or other prizes. Gambling is a game where participants mutually bet against each other, voluntarily risking an amount they paid with the expectation of seeking monetary gain, where winning or losing is determined by chance, some event, or the result of a sports competition. In a lottery, players compete against each other for a prize fund set in advance, while the lottery operator doesn't participate in the game. For gambling, each individual player competes against the gambling operator. It is in the operator's interest to win against the participants. To understand the outcome and possibility of a win requires some skill. People who believe the outcome is sheer luck lack information about the system and underestimate the skill factor that pushes them to participate. Though the commonality between the two is a strong dependency on the luck factor, the lottery ranks itself higher against gambling under the lens of rationality[5].

In the Modern Portfolio Theory by Markowitz (1991) and using the expected return[6] analogy, an individual participating in a lottery shall face a maximum loss of the ticket price they pay (x) and gain of any amount P^L, which can be described as

$$P^L = f(\theta * x) \quad \forall \theta \in \mathfrak{R}^+$$

The maximum loss expected from a lottery is the value of its ticket price, but in the case of gambling, the participant can let go of all their wealth against a betting value, and the loss is much higher.

In the case of gambling, if the participant pays (x) to engage in the gambling session, the expected gain P^G can be described as,

$$P^G = f(\theta * x) \quad \forall \theta \in \mathfrak{R}$$

[4] Refer to https://www.loterijos.lt/en/about-the-association/the-difference-between-lotteries-and-gambling/48#:~:text=In%20a%20lottery%2C%20players%20compete,individually%20against%20the%20gambling%20operator, last accessed on 31st May 2024.

[5] Lottery is considered a more rational engagement than gambling as the lost amount for the lottery is fixed, as is the ticket price. Consider two situations where there is a 50% chance of winning INR 5000 against a 50% chance of losing INR 10 (the ticket price) vs. 50% chance of winning INR 5000 against a 50% chance of losing INR 2500 (the betting amount); the expected utility is higher in the former.

[6] Refer to https://www.investopedia.com/terms/h/harrymarkowitz.asp , last accessed on 31st May 2024.

While there are differences in the expected outcome of both games, one common argument that goes both ways is that gambling and lottery involve thrill owing to uncertainty that differs at a varied level of accessibility.

Figure 1 illustrates the degree of thrill and accessibility involved in these games.

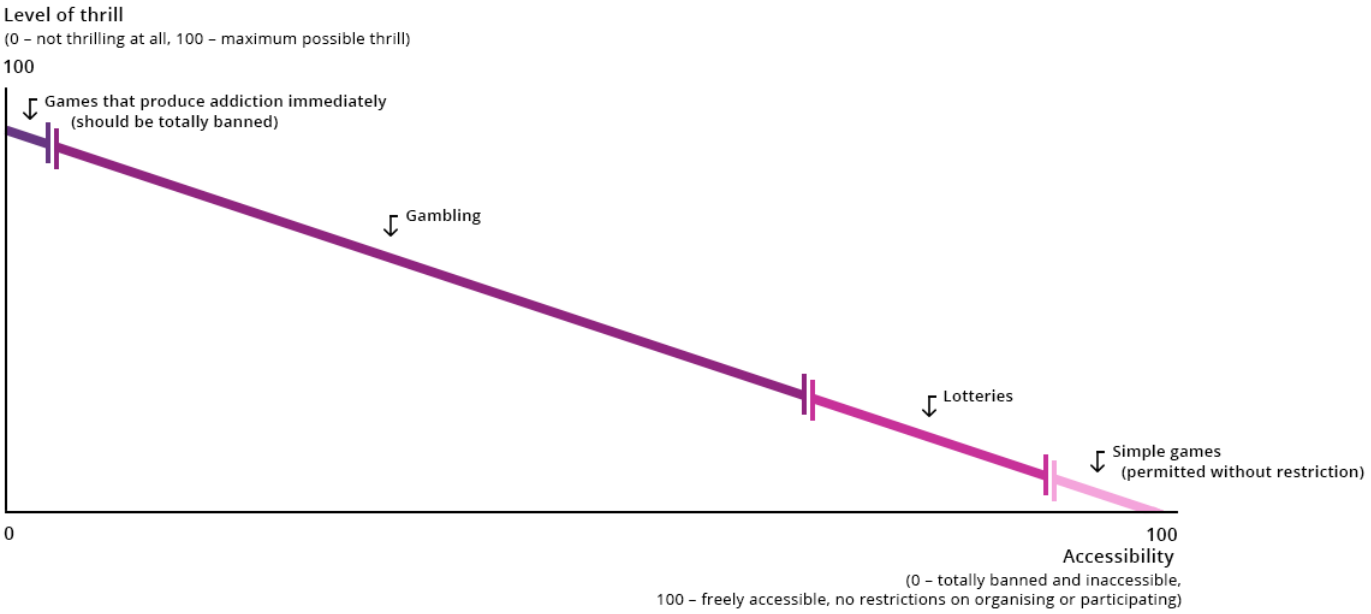

Fig 1: Thrill vs Accessibility. Source: Lithuanian Lottery Association

A concerning question is why individuals seek lottery tickets. According to Friedman and Savage (1948) and Markowitz (1952), people's utility function curves change as they become wealthier (or deviate from their "normal" income). This anticipation of wealth and shift in the utility curve explains why people participating in lottery markets take risks while acting risk-averse in other situations.

The demand for a lottery is contingent more on the gift size than the expected value (Forrest, Simmons, and Chesters, 2002). People participate despite low odds, aligned with the “dream big” narrative. Thus, studies like those by DeBoer (1990) and Cook and Clotfelter (1993) include jackpot size squared to test for a non-linear and positive relationship between jackpot size and ticket sales. According to Blalock and Simon (2007),

per capita income, disposable income, real income, and the poverty rate can be used to capture the regressive nature of lottery spending.

Incorporating the variable factor of measurement of income elasticity across studies, empirical research uniformly finds income elasticities less than one, the relatively lower income strata, are more prone towards lottery spending with an expectation of windfall gain (Suits, 1977; Clotfelter, 1979; Clotfelter and Cook, 1987, 1989). Level of education typically has a negative relationship with ticket sales (Clotfelter and Cook, 1987, 1989; Kitchen and Powells, 1991; Farrell and Walker, 1999).

The rank dependence[7] theory defines pessimism and optimism, which, while formally new, were closely related to classical risk aversion and risk seeking. A relatively new phenomenon, likelihood insensitivity, Henkel, L. (2024), is a concept beyond the classical model that reflects a lack of understanding of risk and uncertainty rather than an aversion or a preference. No similar phenomenon can be modelled with expected utility. In the case of gambling and betting, a dearth of understanding of risk is associated with the participation rate of the people.

A recent article by the British Broadcasting Corporation (BBC) claims that investing in cryptocurrency is like gambling[8]. People's interest and participation in Bitcoin and cryptocurrency have also been meteoric. The complexities of blockchain innovation have set an alarm for regulators across the globe to subjugate laws emphasizing the protection of common people and their livelihood as they consider these as an alternative source of investment. Citing the perils of this technological innovation, a government intervention stands imperative. While a pool of researchers argue that the government should promote the blockchain and cryptocurrency sector, proponents against this idea claim a complete outright ban (Feinstein & Werbach, March 2021). Regulations are also seen for stock market investments designed to safeguard retail investors. Numerous skills and technical knowledge are required to guarantee gains from the stock market and cryptocurrencies. Similarly, an online gambling platform advertising itself as a money-making venture demands adequate skills, knowledge, and idealistic luck to secure gains. Should the regulators be vigilant about gambling engagements becoming income and investment alternatives? How does the law protect participants in gambling?

[7] Refer to https://www.sciencedirect.com/science/article/abs/pii/B9780444537669000173 , last accessed on 31st May 2024.
[8] Refer to https://www.bbc.com/news/technology-65610851 , last accessed on 13th June, 2024.

Legal Ambit of Online Gambling

As per the Constitution of India[9], Gambling is referred to as "Any activity or undertaking whose determination is controlled or influenced by chance or accident or any activity or undertaking which is entered into or undertaken with consciousness of the risk of winning or losing (e.g., prize competitions, a wagering contract)."

One of the key advantages of online gambling is the convenience it offers to players. They can enjoy their favourite games from the comfort of their own homes without having to travel to a physical casino. This accessibility has led to a surge in popularity among individuals who may not have easy access to traditional gambling venues. However, online gambling also comes with its fair share of risks. The internet's ease of access and anonymity can make it difficult for individuals to control their impulses and spending habits. This can lead to financial problems and even addiction for some players, as per the reports from the National Library of Medicine[10].

According to Indian law, the outcome of online gambling is determined by players' skill. The Supreme Court has defined skill games as "the games where success depends on substantial degree of skill or not gambling and despite there being an element of chance of a game is preponderantly a game of skill it would nevertheless be a game of mere skill." Further, the Supreme Court has recognized rummy as a game of skill[11]. Referring to two case laws related to an online gambling platform shall help in understanding the depth of the scenario:

- In *Varun Gumber v. Union Territory of Chandigarh,* the Punjab and Haryana High Court ruled that Dream11, and other digital fantasy sports games are not gambling since they require significant aptitude and skill[12].
- The Bombay High Court ruled in *Gurdeep Singh Sachar v. Union of India and Ors* that a player's ability to employ his skill through better knowledge, judgment, and attention determines whether he wins in the Dream11 game. Fantasy sports like Dream11 are, therefore, a game of skill[13].

[9] Refer to https://legislative.gov.in/constitution-of-india/ , last accessed on 31st May 2024.
[10] Refer to https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8997231/ , last accessed on 8th June 2024.
[11] Refer to https://aklegal.in/online-gambling-the-legal-framework/ , last accessed on 31st May 2024.
[12] Refer to https://aklegal.in/online-gambling-the-legal-framework/#:~:text=In%20Varun%20Gumber%20v.,of%20India%20and%20Ors4. , last accessed on 31st May 2024.
[13] Refer to https://aklegal.in/online-gambling-the-legal-framework/#:~:text=In%20Varun%20Gumber%20v.,of%20India%20and%20Ors4. , last accessed on 31st May 2024.

Online gambling has been a contentious topic in India in recent years. The Indian Law Commission (LCI) encouraged the government to legalize gambling[14] in July 2018[15] by publishing a thorough report urging India to legalize gambling to generate much-needed tax revenue[16]. However, Dream 11 not being considered gambling is contradictory to the provision of the Public Gambling Act of 1867. If betting on cricket matches is still illegal in India, how can Dream 11, which requires the participants to build a team and earn points, be considered just a game of skill and not gambling? Legalizing betting apps that majorly operate from tax heavens raises numerous questions[17]. While the government may legalize gambling, citing a tax revenue benefit, what are the socio-economic costs associated with gambling?

A Dreamy Growth

The fantasy sports sector has been experiencing an indomitable growth trajectory over the last 8 years. The large-scale advertising on multiple media and the ease of access enhances the narrative of online gambling being a reliable and easy alternative source of income. One of the segment leaders, Dream 11, with a 14 crore user base[18], started its operation in 2008 and has never experienced a loss in its business. Though the founders, Harsh Jain, and Bhavit Sheth, are associated with renowned industrialist late Dhirubhai Ambani[19], the company has received multiple legal show-cause notices for tax evasion[20].

Dream11 earned a total revenue of INR 6,590 crore for FY23, a jump of 62.4 percent from INR 4,058 crore in FY22. Revenues from operations grew to INR 6,375 crore in FY23, registering a massive growth of 66.3 percent from INR 3,833.5 crore in FY22. Profit after tax increased by 51.7 percent to Rs 223 crore in FY23 from INR 147 crore in FY22[21].

[14] Refer to https://timesofindia.indiatimes.com/city/chandigarh/playing-fantasy-games-online-not-betting-high-court/articleshow/59925686.cms , last accessed on 31st May 2024.
[15] Refer to https://lawcommissionofindia.nic.in/report_twentyfirst/ , last accessed on 31st May 2024.
[16] Refer to https://cdnbbsr.s3waas.gov.in/s3ca0daec69b5adc880fb464895726dbdf/uploads/2022/08/2022081655-1.pdf, last accessed on 31st May 2024.
[17] Refer to https://scroll.in/article/1061528/what-drives-the-lucrative-murky-world-of-online-cricket-betting-in-india#:~:text=Since%20gambling%20on%20live%20sports,which%20have%20little%20corporate%20regulation last accessed on 13th June 2024.
[18] Refer to https://yourstory.com/2023/01/fantasy-gaming-unicorn-dream11-revenue-net-profit-earnings , last accessed on 5Th June 2024.
[19] Refer to https://startuptalky.com/dream11-biggest-fantasy-game-india/ , last accessed on 5th June 2024.
[20] Refer to https://www.moneycontrol.com/news/technology/dream11s-fy23-revenue-soars-by-66-auditor-flags-impact-of-gst-demand-12088371.html , last accessed on 5Th June 2024.
[21] Refer to https://www.moneycontrol.com/news/technology/dream11s-fy23-revenue-soars-by-66-auditor-flags-impact-of-gst-demand-12088371.html , last accessed on 5Th June 2024.

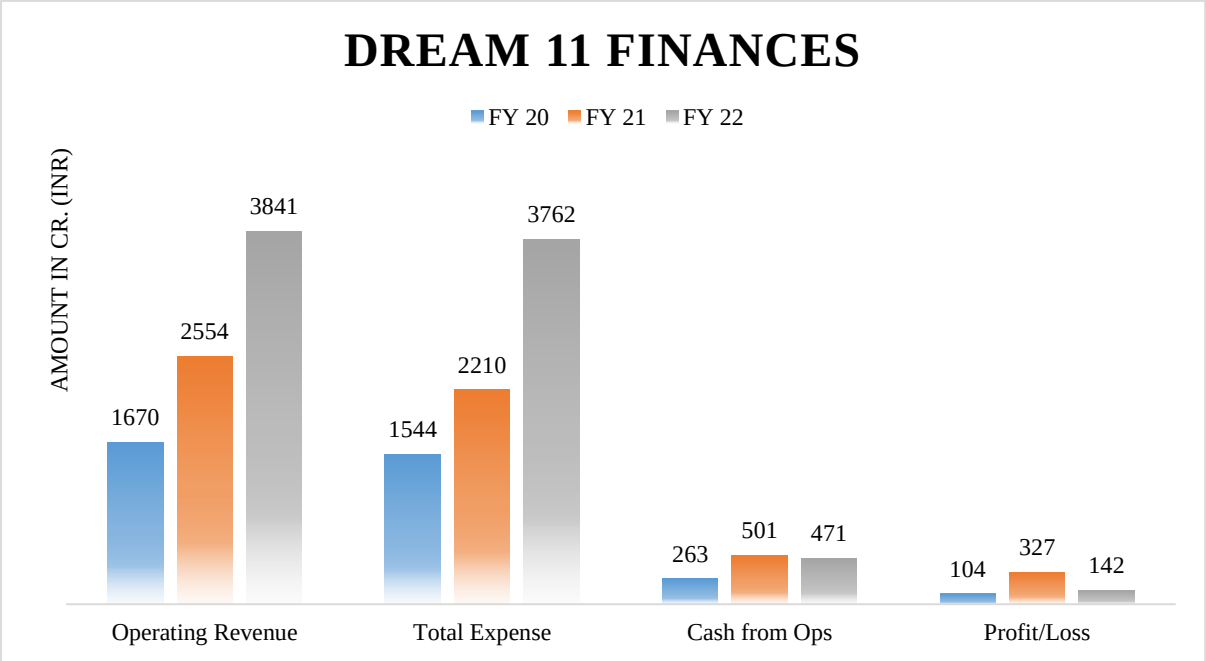

Fig 2: Dream 11 Finances. Source: Entrackr[22] and moneycontrol

	FY 21	FY 22
EBITDA margin	13.33%	4.60%
Expense / ₹ of Op Rev	₹0.87	₹0.98
ROCE	19.36%	6.08%

Fig 3: Dream 11 data. Source: Entrackr and moneycontrol

To target more customers, especially the youth, Dream11 spent heavily on advertising and promotions. The company focused on marquee sporting events such as the Indian Premier League (IPL) cricket tournament to attract more customers. As the revenue model requires people to pay a sign-up amount, with the promise of potentially enormous wins through betting, aggressive advertisement is imperative to attract more people. As per multiple reports, the advertisement cost soared high post-COVID as people's engagement time was reduced owing to the resurrection of regular livelihood activities.

[22] Refer to https://entrackr.com/2023/01/dream11s-gross-revenue-crosses-rs-4000-cr-in-fy22-profit-dips-56/ , last accessed on 5Th June 2024.

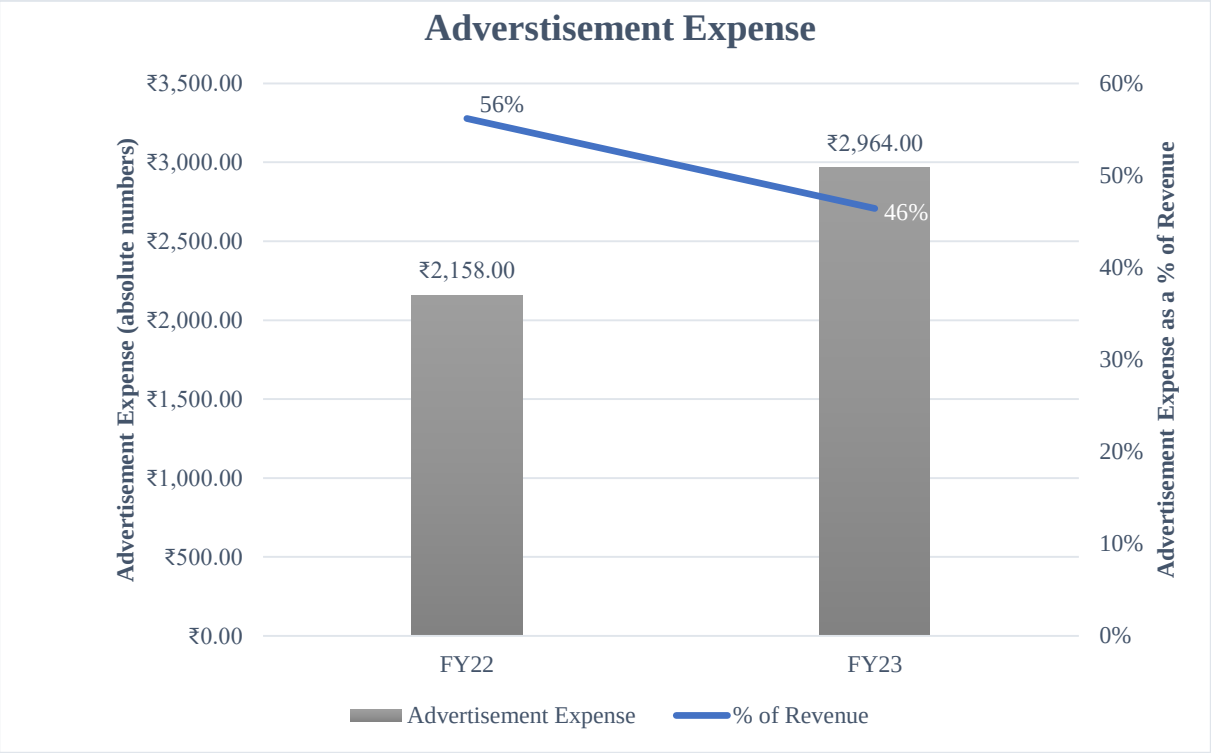

Fig4: Dream 11 advertisement expenses. Source: moneycontrol

The competitors are not behind in the league. As per a report from Moneycontrol, rival Gameskraft earned a total profit of INR 1,061.86 crore on revenues of INR 2,732.11 crore for FY23, an improvement from INR 930.5 crore profit on revenues of INR 2,153.24 crore in FY22. Mobile Premier League (MPL)'s overall revenue grew to $104.63 million in FY23, a 63 percent increase from $64.2 million in FY22. The company's revenues from the Indian market grew 23 percent to INR 521.8 crore ($64.7 million) in FY23 from INR 424.4 crore ($57.2 million) in FY22.

Social Cost and Benefit of Gambling

The presence of online gambling companies has proliferated in India over the past decade, creating a few employment opportunities in that sector as an upside. Though the social benefit is limited to some specialized and particularly skilled jobs, social costs are extensive. Internet and technology have given people easy access to venture into the platforms and test their luck of winning big. Time and again, people have fallen victim to the aggressive advertisement of these platforms, promising credible engagement and monetary gains. Lower-income people are prone to such overwhelming promises to change their financially destitute destinies. Researchers at Bristol University have reported a rise in gambling promotions that typically blur the line

between advertising for a betting company and popular cultural references. According to The Guardian newspaper, advertisements on social media are alluring young minds into gambling[23]. Social shaming and vilifying the victim, unless they commit suicide, once they lose money and, at times, properties, is a common phenomenon; incidents of a similar type have been witnessed in Tamil Nadu, India[24]. Online sports gambling has victims worldwide. Even highly educated young people fall prey to the decisive and aggressive advertisement campaigns run by these platforms[25]. Are the regulators doing enough to protect these victims, or has the tax revenue set the priority in precedence?

Discussion and Implications

The evolution of online gambling, especially through platforms like Dream11, has reshaped the landscape of both leisure and financial aspirations in India. While these platforms offer significant revenue potential and attract a broad user base, the socio-economic implications are profound. Lower-income populations, particularly vulnerable to the idea of quick financial gain and a sense of control over gambling fortunes, given the shallow role of skills, often find themselves entangled in a cycle of loss and dependency. This vulnerability is exacerbated by aggressive marketing tactics and the inherent risks associated with gambling. Since the inception of online sports gambling, the narrative was meticulously changed to an engagement promising a windfall income and a lucrative association contrary to any other work. The advertisement claims, using a few celebrity sports personalities, that spending time on these platforms is the best means of engagement. Any other work is too discernible, thus rendering it futile. People often fail to interpret the terms and risks associated with such participation and overestimate the brighter side, staying unaware of the probable losses. A system propagating the show, with multiple victims falling prey frequently, is to be questioned on the same line as the showrunners. An income source that has the potential to put the shelter on a bet is nothing less than a gusty strong cyclone against and contradictory to the promising windfall monetary gain. Additionally, promoting alternative and sustainable income sources through vocational training and skill development can offer more reliable economic opportunities for vulnerable populations.

Dream 11 has 14 investors, of whom 11 are from the UK, USA, and China, taking up the company's value to USD 8bn as of November 26, 2021[26]. While the information for companies like OYO hotels and Zomato, with a valuation of USD 6bn and USD 12bn, respectively, are publicly available owing to IPO regulations, these

[23] Refer to https://www.theguardian.com/society/2024/mar/17/sneaky-social-media-ads-are-luring-young-into-gambling-say-campaigners , last accessed on 31st May 2024.
[24] Refer to https://frontline.thehindu.com/society/families-of-online-gambling-victims-in-tamil-nadu-live-in-shame/article66751333.ece , last accessed on 31st May 2024.
[25] Refer to https://www.cbc.ca/news/canada/saskatoon/single-event-sports-betting-problem-gambling-young-men-1.6497962 , last accessed on 31st May 2024.
[26] Refer to https://tracxn.com/d/companies/dream11/__1dAVn3JI_7QbZShc9kcJ2YGsdEGr8s3l1MZSoAbKF_A/funding-and-investors#:~:text=TCV%2C%20D1%20Capital%20Partners%20and,held%20on%20Mar%2024%2C%202021, last accessed on 8th June 2024.

gaming platforms with a gigantic valuation are barely required to present their financial and non-financial details, making it tough to comment on their financial stability, spend and source. Given the lack of transparency and substantial growth, can these gambling platforms become an easy alternative to convert black money to white? Can they help wade tax? Moreover, these platforms' financial stability and profitability contrast sharply with the financial distress experienced by many of their users. This dichotomy underscores the need for a balanced approach in policy-making that considers both the economic benefits and the social and economic costs.

Policymakers must address the negative impacts of online gambling by implementing stricter regulations and providing better public awareness about the risks involved. In India, where 71% of the adults do not have upper secondary education[27], as per OECD data, can a high-risk gamble be let off as a game of skill? If regulations are imperative for stock markets and cryptocurrencies, what hinders a regulatory act against online gambling?

To conclude, while the digital transformation of gambling has created new economic opportunities, it is necessary to safeguard against its potential costs. A comprehensive regulatory framework, robust disclosure, and public education and support systems are essential to mitigate the adverse effects and ensure a balanced approach to this rapidly evolving industry.

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Indian Corporates Capture Berths in Global ESG Assessment – Cases of Select Indian Companies

Akinchan Buddhodev Sinha

Introduction

Corporate governance has witnessed metamorphosis over a period of time. Its vastness like an ocean has encompassed various critical developments that have occurred at different periods in the corporate world to safeguard stakeholders' interests.

Various events such as financial fiascos or scams, business failures due to lack of accuracy in the prognosis of future changes in the legal, economic and business environment, top leadership's lackadaisical approach towards the concerns of external and internal stakeholders, Lack of perspicacity in assessing business failures post mergers and acquisitions, inability to assess the magnitude of various forms of risks, especially the systemic risks in VUCA world (V-Volatility, U-Uncertainty, C-Complexity and so on have created tremors among the stakeholders, especially the investors who invest their funds through various investment routes like equity, debt, derivatives etc.

The developments above and growing awareness of business organisation's obligation towards the environment, society, suppliers, customers, human capital, etc. have led to the birth of a unique and indispensable concept, i.e., ESG.

ESG includes vital dimensions that wield a robust impact on the leadership and management style, business approaches / models, etc., since the components covered under environmental, social, and governance (ESG) are driven by standards and reporting standards at both global and national levels. Today, a company merely cannot go on conducting business activities without paying heed to issues like air and water pollution, biodiversity loss, fair pay for employees, diversity, equity, and inclusion, building strong relationships with the communities in which it runs its business activities, board diversity, executive compensation policies, risk management, etc. and these are the elements that are bundled in ESG, and if an organisation fails to deliver on any of the components of ESG then somewhere it may exert a debilitating impact on the goodwill of the organisation as well as cajole legal actions in some cases.

In view of the soaring focus on ESG, it can be observed that corporate performance is gauged on ESG yardsticks by various ESG assessment organisations and one such organisation which has undertaken Corporate Sustainability Assessment is S&P Global. It is heartening to note that some Indian corporate houses affiliated with various sectors have also appeared in S&P Global's Sustainability Yearbook 2024 which contains the Corporate Sustainability Assessment of 2023 wherein more than 9,400 companies were assessed, and this is the major trigger for undertaking research of the performance of select Indian companies on ESG dimensions under the five categories considered for Corporate Sustainability Assessment by S&P Global.

The ensuing paragraphs throw light on the initiatives that have been taken by the Indian companies considered for the research study under various yardsticks of Environmental, Social, Governance & Economic dimensions of S&P Global's Corporate Sustainability Assessment.

Findings, Analysis, and Discussion

Indian companies that have captured berths in S&P Global's Corporate Sustainability Assessment Report under the mentioned categories are as under

1. **Top 1% S&P Global CSA Score**

i) Hindustan Zinc Limited (*Industry: Metals & Mining*)

ii) Hindalco Industries Limited (*Industry: Aluminium*)

2. **Top 5% S&P Global CSA Score**

i) Tech Mahindra Limited (*Industry: IT Services*)

3. **Top 10% S&P Global CSA Score**

i) Vedanta Limited (*Industry: Metals & Mining*)

ii) Dr. Reddy's Laboratories Limited (*Industry: Pharmaceuticals*)

iii) Macrotech Developers Limited (*Industry: Real Estate Management & Development*)

iv) JSW Steel Limited (*Industry: Steel*)

v) Hindustan Unilever Limited (*Industry: Personal Products*)

vi) Mahindra & Mahindra Limited (*Industry: Automobiles*)

The companies considered from different sectors of the Indian economy have been considered as samples for exploring their accomplishments in "E", "S" and "G" parameters under each category along with highlighted criteria and dimension weights as determined by S&P Global CSA Score are: Hindustan Zinc Limited, Tech Mahindra Limited, Dr. Reddy's Laboratories Limited, Dabur India Limited, and PI Industries Limited.

Since the Corporate Sustainability Assessment (CSA) was conducted by S&P Global in 2023, in view of this, to comprehend the performance of the above mentioned companies on various ESG dimensions, their annual integrated reports of 2022-23 have been considered for the analysis.

Category 1: Top 1% S&P Global CSA Score

Company: Hindustan Zinc Limited

Industry: Metals & Mining

Highlighted Criteria & Dimension Weights	Companies performance on Highlighted Criteria (Based on Annual Reports 2022-2023)
Environmental Dimensions- 34% •Biodiversity •Climate Strategy •Waste •Water *Social Dimension- 33%* •Occupational Health & Safety •Social Impacts on Communities *Governance & Economic Dimensions- 33%* •Business Ethics •Corporate Governance •Risk & Crisis Management	The performance of the company under Environmental, Social, and Governance & Economic Dimensions has been broadly explored based on the company's Sustainability Goals for 2025. <u>Environmental Dimension</u> i) *Climate Change-* a) Compared to the base year 2017, the company has achieved 0.5 mn tCO2e Greenhouse gas (GHG) emission savings in its operations. As part of its net-zero journey, the company strives to address climate change. b) The company has revised its emission targets to make them more stringent. c) The target revisions in the GHG emissions by the company are expected to help in attaining net-zero emissions by 2050 or even earlier in the long term. Most significantly, target revisions in the GHG emissions will assist in bringing down Scope 1 and Scope 2 emissions by 50% and Scope 3 emissions by 25% by 2030. ii) *Water Stewardship-* The company aims to become 5x water-positive and attain a 25% reduction in fresh water usage. In this regard, the company is striving to accomplish water stewardship goals by espousing a strategic approach that takes cognizance of the following dimensions: a) Reducing freshwater usage. b) Reconnoitring alternative water solutions. c) Enhance the usage of recycled water. d) Exploring groundwater replenishing mechanism. e) Oversight and auditing of water consumption by end users, withdrawal of water from its source, ensuring of water balance, water quality including efficiency of waste treatment facility. iii) *Circular Economy-* a) The company aims to achieve 3x increase in gainful utilization of smelting process waste. Given this, the company's Waste to Wealth Community is

	working on a war footing basis to determine methods for recycling and optimum utilization of the waste obtained during the manufacturing process. b) On a pilot basis, the company is working with a Calgary-based technology company that has created the capacity to utilize mine waste to manufacture cement-like materials that assist in preserving resources, have a lower hazardous impact on the ecosystem, and help in lowering GHG emissions. c) The company produces value-added products from residual smelter waste. iv) *Biodiversity Conservation*- a) The company has drafted exclusive biodiversity plans for every operation site. b) Biodiversity management initiatives encompass biodiversity risk assessment, afforestation programme, re-establishment of exhausted waste dumps, preservation of schedule-1 fauna species etc. c) The company has joined hands with the International Union for Conservation of Nature (IUCN) for reviewing its biodiversity management plans and to align its activities in such a manner that it leads to no net loss. <u>Social Dimension</u> i) *Social Impact*- With reference to social impact, the company's initiatives under the social dimension have positively impacted one million human souls. ii) *Diversity in Workforce*- Inclusiveness and substantial workplace diversity may be observed. The workplace diversity of the company stood at 30%. iii) *Ensuring Zero Harm*- The company exhibited nil work-related fatalities. Moreover, there is a mammoth drop in total recordable injury frequency rate (TRIFR) i.e., 50%. iv) Five CSR Programmes of the company – Zinc Kaushal, 4000+ youth benefitted since FY 2019-20; Unchi Udaan, Zinc Football Academy, 4000+ youth benefited since FY 2017-18; Sakhi Microenterprise, 27,000+ women benefitted since FY 2019-20 and Drinking water, 100,000 villagers benefitted since FY 2018-19. <u>Governance & Economic Dimensions</u> i) *Responsible Sourcing*- With reference to the supply chain, the company espouses 100% responsible sourcing approach.

	ii) To ensure optimal responsible outsourcing, the company has embraced responsible outsourcing guidelines of London Metal Exchange (LME) and Organisation for Economic Cooperation and Development (OECD). iii) Espousing supplier sustainability assessment. iv) Conducting of training programs to sensitize on human rights. v) Thrust on local procurement.

Category 2: Top 5% S&P Global CSA Score

Company: Tech Mahindra Limited

Industry: IT Services

Highlighted Criteria & Dimension Weights	**Companies performance on Highlighted Criteria (Based on Annual Reports 2022-2023)**
Environmental Dimensions- 23% • Climate Strategy • Environmental Policy & Management Systems *Social Dimension- 35%* • Customer Relationship Management • Human Capital Development • Privacy Protection • Talent Attraction & Retention *Governance & Economic Dimensions- 42%* • Business Ethics • Information Security/ Cybersecurity & System Availability • Innovation Management	<u>Environmental Dimension</u> *Climate Change:* i) During FY23, Tech Mahindra's Scope 1+2 emissions declined by 40% against base year, i.e. FY16. However, a slight increase of 2.7% was observed against FY22 due to the resumption of work by its human capital from the workplace. ii) The company gives due emphasis on transforming itself into a net zero organisation. The company's determination to become carbon neutral and attain net zero by 2030 and 2035 respectively is evinced by the fact that it has inked the SBT (Science-based Target) initiative of Business Ambition of 1.5°C. iii) The company has become part of the 1.5° Supply Chain Leaders by the Exponential Roadmap Initiative (ERI) to engender a decline in GHG emission across the value chain. iv) The company is striving to reduce the environmental impact of its operations by making its facilities energy efficient as well as embracing initiatives to adhere to green building norms by ensuring installation of recycling equipment, air and water purification systems, etc. <u>Social Dimension</u>

	i) Intending to bolster the next generation, the company conducts 62 SMART (Skills-for-Market Training), 13 SMART-T (technical), and 9 SMART + centres across 11 cities. These centres offer 52 sector-specific courses for skill enhancement across 14 domains to youths and people with disabilities. ii) CSR highlights of FY23: a) Youth upskilling - 22,596 youths including 1,303 persons with disabilities trained. b) Catalyst for education- Trained 4,379 teachers and provided special education to 4,829 children having disabilities. iii) To foster employee engagement, the company organizes 'Meet & Greet' events across various locations for newly joined employees. iv) The company provides a conducive work milieu for members of LGTBQ+ communities, socio-economically backward people, and persons with disabilities. v) As evident from the company's CSAT (Customer Satisfaction Score) Index, it may be opined that the company has improved prodigiously in achieving customer satisfaction. The CSAT Index was 4.46 in 2022-23 against the target of 4.50 and it was quite high compared with the CSAT Index of 3.0 in Base Year 2020-21 and most significantly satisfied customers were a whopping 75% during 2022-23. vi) Data governance is given due importance and most significantly it is reviewed by the risk management committee. Moreover, the company has an Information Security Group which is entrusted with numerous levels of surveillance. It is to be noted that the company possesses the following crucial certifications for its strong information security standards- ISO 27001:2013, ISO 27701:2019, ISO 22301:2019. <u>Governance & Economic Dimensions</u> i) Company's board's composition is a metaphor of independence and diversity. ii) The noteworthy facets of corporate governance of the company for FY23 are: a) Focus on board's independence with 6 Independent Directors and 3 Non-Executive Directors. b) Average board tenure is 7.8 years

	c) The human capital has perused the Code of Conduct of the company. d) Ethics and Compliance have been encompassed under 'Major' category in the Materiality Index for FY23.

Category 3: Top 10% S&P Global CSA Score

Company: Dr. Reddy's Laboratories Limited

Industry: Pharmaceuticals

Highlighted Criteria & Dimension Weights	**Companies performance on Highlighted Criteria (Based on Annual Reports 2022-2023)**
Environmental Dimensions- 13% • *Environmental Policy & Management Systems* *Social Dimension – 42%* • *Access to Healthcare* • *Health Outcome Contribution* • *Human Capital Development* • *Marketing Practices* • *Talent Attraction & Retention*	<u>Environmental Dimension</u> The goals and targets of the company under the environmental dimension are as under: **Goal** / **Target** / **Progress this year** Leading the energy transition — The company aims to use 100% renewable energy by 2030 for its business operations. — The company met its 42% power requirements through renewable resources. Pathway to carbon neutrality — The company strives to accomplish carbon neutrality in its operations, i.e., Scope 1&2 emissions by 2030. — The company achieved 30% carbon neutrality. Addressing the global water crisis — Dr. Reddy's Laboratories Limited envisions becoming a water-positive company by 2025. — The company has accomplished the target of being water-positive. Building a resilient value chain. — By 2030, the company's target is to attain a 12.5% reduction in indirect carbon emissions across its supply — The company's revised Scope 3 emissions inventory stands complete. Most strikingly, the emissions reduction plan of

Governance & Economic Dimensions- 45%

- *Business Ethics*
- *Innovation Management*
- *Product Quality & Recall Management*

	chains, i.e., Scope 3 emissions.	the company has gained steam.

Social Dimension

Goal	Target	Progress this year
Advancing access to medicines.	By 2030, serve 1.5 billion patients.	689 million+ patients reached.
Enhancing affordability of medicines.	25% of new product launches of the company will hit the market first by 2027.	39% first-to-market new launches.
Innovating for better health.	With effect from 2027, the management of the company targets to bring out three innovative elixirs every year to enhance the treatment levels.	The company has espoused innovative solutions for providing impetus to better treatment.
Gender diversity.	The company targets to have at least 35% women in top management level by 2030.	Adequate representation women on the company's board.
Gender equity.	The company aims to accomplish gender parity by 2035.	Globally the company's gender diversity stood at 18%
18% gender diversity globally.	The management strives to have at least 3% people with disabilities as part of its human capital by 2030.	The current human capital of the company comprises of 0.4% employees with disabilities.
Equity and fairness for all.	The management aims to ensure living wages for its extended human capital by 2025.	To bridge the gulf in living-wage, the management has chalked out a plan and also roped in a strategic partner.

Governance & Economic Dimension

Goal	Target	Progress this year

	Excellence in compliance, ethics and corporate governance.	The company has strong corporate governance in place with highest emphasis on compliance and ethics.	The company has robust corporate governance framework with no major variance.
	Greater transparency and improved reporting.	The management of the company wish to increase ESG disclosures to capture top quartile.	The company has embraced comprehensive BRSR Integrated Reporting, Independent Assurance and increased ESG disclosures.
	Engaging our suppliers.	Ensuring 100% strategic suppliers of the company complies with the company's ESG structure by 2030.	The company has completed capacity building and audit of suppliers is in process.

Category 4: Industry Mover

Company: Dabur India Limited

Industry: Personal Products

<table>
<tr><th>Highlighted Criteria & Dimension Weights</th><th>Companies performance on Highlighted Criteria (Based on Annual Reports 2022-2023)</th></tr>
<tr><td>Environmental Dimensions- 27%
Biodiversity
Product Stewardship
Social Dimension - 36%
Customer Relationship Management
Occupational Health & Safety
Sustainable Marketing & Brand Perception</td><td><u>Environmental Dimension</u>

i) Climate Change:
<table><tr><th>Goal</th><th>Achievement</th></tr><tr><td>Achieve Net Zero in the entire value chain by 2045.</td><td>Company aims to attain net zero science-based targets.</td></tr><tr><td>Eliminate coal across own manufacturing units by FY 2024-25.</td><td>The company has carried out successfully coal-free operations trials during June 2023.</td></tr></table></td></tr>
</table>

Governance & Economic Dimensions - 37%

- Business Ethics
- Innovation Management
- Product Quality & Recall Management
- Supply Chain Management

Achieve >60% Scope 1 and Scope 2 energy from renewable and cleaner sources by FY 2025-26.	Renewable energy contributes 50% of the total energy consumed in operations.

ii) *Biodiversity*:

Goal	Achievement
Ensure own manufacturing operations outside Bio Endangered/protected biodiversity zones.	Hundred percent of the Company's operations carried out outside the limits of biodiversity zones.
Ensure 100% Afforestation equivalent to sourced critically endangered herbs by FY 2025-26.	a) The company's conservation and restoration initiatives have assisted prodigiously in mitigating 50% of the risk about critically endangered herbs. b) The total area cultivated in FY 2022-23 is 7,731 acres. A mammoth increase of 47% in the cultivation of medicinal herbs in FY 2022-23 in comparison to FY 2020-21.

ii) *Water Dimension*:

Goal	Achievement
Reduce Water Intensity in operations by 30% by FY 2025-26.	Despite registering a massive increase in water intensive 'Juices' portfolio, the company reduced the water consumption, i.e., water intensity (kL/ MT) by 22% from FY 2018-19.
Become water-positive in your own operations and communities by 2030.	Dabur's community-led water conservation initiates played a pivotal role in the recharging of

	water. The efficacy of the mentioned initiatives is evident from the huge quantum of water, i.e., 77,412 KL recharged since FY 2018-19.

iii) *Circular Economy:*

Goal	Achievement
Move from Plastic Waste Neutrality in 2021-22 to Plastic Waste Positivity in 2022-23.	Dabur became a champion in plastic waste management in 2022-23 by collecting, recycling, and processing of 35,000 MT of post-consumer plastic waste.
80% reusable, recyclable, or compostable packaging by 2028.	
Use 30%, 10%, and 5% of recycled plastic packaging content in plastic packaging of non-food grade items for Category I, Category II, and Category III plastics, respectively, by FY 2025-26.	
Promote circularity in the value chain.	

Social Dimension

i) *Social Impact*:

Goal	Achievement
Transform the lives of 2.5 Million people by 2023 and 5 Million by 2030 in a sustainable manner.	2.76 million people benefited in 2022-23, an enormous hike of 21% over 2021-22.
Sustainably cultivate medicinal and aromatic plants	The land under cultivation till 2022-23 was 7,731 acres.

on 15,000 acres by 2030 (200% increase over 2020).	
Enhance the livelihood of more than 13,500 farmers' families by 2030 (100% increase over 2020)	a) For growing herbs and apiculture, the companies engaged 9,653 farmers and 11,220 beekeepers respectively. b) Farmers were distributed 32.5 lakh saplings free of cost in FY 2022-23.

ii) *Product Responsibility*:

Goal	Achievement
Progressively reduce added sugar content in juices.	Sugar content in the products of the company has been reduced by 20.95% since 2018.

iii) *Diversity & Inclusion*

Goal	Achievement
18% gender diversity at the managerial level by 2028.	The company registered a 70 bps enhancement in gender diversity in its workforce.

<u>Governance & Economic Dimensions</u>

i) *Governance*:

Board's independence is on the higher side, i.e., 57%.

- The audit committee has 100% independence.

- Independent Directors lead majority of the Committees, i.e., 5 out of 6 committees.

- Higher attendance in board meetings at 98.6%.

<table>
<tr><td></td><td>
- Average attendance in various committees stood at 96%.

- The company has constituted an ESG Committee to have supervision on environmental, social, and governance-related issues

Additional Information-

- The ESG Committee of the board included an Independent Director in May 2023.

- The company's management appointed a Lead Independent Director in May 2023.

- The company's board witnessed a jump in gender diversity from 7% to 14% during FY2023-24.

ii) Responsible Outsourcing:
<table>
<tr><th>Goal</th><th>Achievement</th></tr>
<tr><td>Ensure zero deforestation due to high-risk materials by FY 2025-26 through 100% sustainable sourcing.</td><td>a) FSC certified vendors were only considered by the company for paper outsourcing and Tetra Pak laminate.

b) A whopping 97% of corrugated boxes were procured from sustainable sources by the company.

c) A mammoth 84% of sustainable sourcing by the company of such materials has a high magnitude of deforestation risk.</td></tr>
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</td></tr>
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Category 5: Member

Company: PI Industries Limited

Industry: Chemicals

Highlighted Criteria & Dimension Weights	**Companies performance on Highlighted Criteria (Based on Annual Reports 2022-2023)**
Environmental Dimensions - 34%	<u>Environmental Dimension</u>

- Climate Strategy
- Emissions
- Product Stewardship
- Waste
- Water

Social Dimension- 32%

- Human Capital Development
- Occupational Health & Safety

Governance & Economic Dimensions- 34%

- Business Ethics

Innovation Management

Company's 2025 Goal	SDG alignment	Progress till FY23
Increase renewable energy usage to 20 percent of the total	SDG 12: Responsible Consumption and Production	Out of the total electricity consumed by the company, 4.83% is consumed from renewable resources.
Reduce Specific CO2 emissions by 25 percent	SDG 12: Responsible Consumption and Production	The company has reduced specific CO2 emissions by 15%
Reduce landfill waste by 25 percent	SDG 12: Responsible Consumption and Production	The pace of the landfill waste reduction process has increased by 63%.
Reduce specific freshwater consumption by 25 percent	SDG 6: Clean Water and Sanitation SDG 12: Responsible Consumption and Production	The company has already brought down the consumption of specific fresh water by 12.6%.

Social Dimension

Company's 2025 Goal	SDG alignment	Progress till FY23
Today's IC for your necessary action, please.	SDG 3: Good health and well-being SDG 8: Decent work and economic growth SDG 16: Peace, Justice, and Strong Institutions	0.068 in FY23 for all employees and contract workers

Ensure NIL fatal injury in plant operations.	SDG 3: Good health and well-being SDG 8: Decent work and economic growth SDG 16: Peace, Justice, and Strong Institutions	NIL
Increase employees' average training hours per full-time employee by 25 percent	SDG 8: Decent work and economic growth	Increased by 62%
Increase women's participation in leadership positions by 25 percent	Gender Equality	Increased by 23%

Governance & Economic Dimensions

Material Topic	**SDG alignment**	**Initiatives undertaken and Company's achievements in FY23**
Corporate Governance and Business Ethics	SDG 16: Peace, Justice, and Strong Institutions	a) The company upholds the highest standards of corporate governance and business ethics and follows a strong compliance management team b) The company revisits its compliance management system periodically to stay updated and in line with regulations
Risk Management	SDG 11: Sustainable Cities and Communities	The company has a robust risk management system which includes the identification of such risks, their analysis and formulation of risk management and mitigation

		SDG 13: Climate Action	strategies, and the implementation of the same

Conclusion

Thus, from the aforesaid discussion it may be stated that Indian corporate sector is making rapid strides in the area of ESG. People, Planet and Profit have become the focal point of corporate sector. From their proclivity towards ESG, it is evinced that if corporate world is utilising natural and human resources for production of goods or services then they are also giving back to the society by taking utmost care of 'Mother Earth' and by espousing approaches that is assisting prodigiously in reducing environmental pollution, address the issue of climate change, biodiversity loss, waste management etc.

A paradigm shift in corporate philosophy can also be observed with reference to human capital and society. Previously, these two vital elements were either completely overlooked or little attention were paid towards them. But with the passage of time and with the onset of various laws and regulations governing the corporate landscape, the scenario has changed drastically. Moreover, various developments in ESTEMPLE factors (E-Economic, S-Social, T-Technological, M-Media, P-Political, L-Legal and E-Ethical) have resulted into commencement of odyssey of corporate world on the trajectory of ESG.

Developments such as identification of six capitals by the International Integrated Reported Council (IIRC), i.e., financial capital, manufactured capital, intellectual capital, human capital, social and relationship capital; European Sustainability Reporting Standards (ESRS); Global Reporting Initiative (GRI); International Sustainability Standard Board's IFRS 1: General Requirements for Disclosure of Sustainability-related Financial Information and IFRS 2: Climate-related Disclosures etc. at international level and BRSR Core framework issued by the Indian capital market regulator, Securities and Exchange Board of India (SEBI) to foster listed companies to provide disclosure about their environmental, social and governance practices and impacts along their value chain all culminates into one concept and that is ESG.

Securing of berths by the Indian companies in the S&P Global's Sustainability Yearbook-2024 is no doubt a mammoth accomplishment and it can be stated without an iota of doubt that the mentioned exaltation is just a beginning for Indian corporate sector and soon, we may witness elevation of more Indian companies to the Top 1% S&P Global CSA Score from Top 5% S&P Global CSA Score and Top 10% S&P Global CSA Score.

Further, more and more Indian companies affiliated to various sectors of Indian economy should strive to feature in S&P Global and similar other international corporate sustainability assessment reports, thereby enhancing the global footprints of Indian corporate houses and at the same time propagate the message to globe that India is progressing on ESG at an astounding pace.

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Redefining Lending: Harnessing Financial Engineering in the Modern Era

Gouri Sankar Sahoo

Financial engineering has brought about a comprehensive change in the different areas of finance, such as credit lending. Financial engineering has resulted in more efficient, precise, and reliable models for loaning by making use of sophisticated mathematical and computational techniques (Bodie et al., 2014).

Financial engineering is the application of mathematical and computational techniques related to financial instruments in resolving complex problems. This involves developing new financial instruments and creating innovative risk management strategies. The components of financial engineering include mathematical modeling, complex statistical analysis, and advanced computing tools (Hull, 2015).

The traditional lending models have relied heavily on credit scoring systems such as CIBIL, Equifax, and Experian (in Indian Context) that use historical data to assess borrowers' creditworthiness. These models consider credit history, income levels, employment status, and debt-income ratios. However, these methods have limitations like limited data usage and non-real-time analysis on subjectivity grounds (Thomas et al., 2002).

1. Role of Financial Engineering in Modern Lending Models

Modern lending models have been improved by financial engineering, which makes use of sophisticated mathematical, statistical, and computational methods. This encourages more accurate credit ratings, improved risk management, and enhanced customer experiences. Some of the major areas where financial engineering has a significant influence on lending models are as follows:

I. Advanced Credit Scoring Models

These comprise intricate mathematical models developed by financial engineers that incorporate information from various sources such as:

Alternative Data: In addition to conventional credit information, modern-day models utilize unconventional types of data, including social media activity and utility payments, among others (Hurley & Adebayo, 2016). This wide range of data gives a better picture of borrowers' money status.

Machine Learning Algorithms: On the other hand, Machine learning techniques are ML techniques that find patterns and correlations in vast data sets. These algorithms constantly learn and adapt based on new data, resulting in more accurate and dynamic credit scoring models (Boeckenholt, 2012).

Real-Time Analysis: Through financial engineering, lenders can have real-time data processing to take instant decisions on the most current information. This is especially useful in online and mobile lending platforms where speed of approval is critical (Petersen & Rajan, 2002).

Case Example: ZestFinance uses machine learning technology for credit risk assessment, which involves thousands of data points to provide a comprehensive view of borrowers. As a result, ZestFinance has been able to lend to high-risk individuals who would not qualify under conventional models, thereby increasing access to credit while maintaining default rates at low levels (ZestFinance, 2021).

II. Risk Management and Fraud Detection

In lending, it is very important to manage risks effectively. What contributes to this, according to Financial Engineering:

Predictive Analytics: Sophisticated predictive models measure the probability of default by considering various risk factors and their relationships. Lenders use these models to manage and mitigate credit risk proactively (Thomas et al., 2002).

Fraud Detection: To find fraudulent activities among them, transaction patterns analysis, device information, and behavioral data mining are conducted by financial engineers. Such algorithms utilize statistical methods that identify anomalies or flag suspicious transactions requiring further investigation (Bolton & Hand, 2002).

Case Example: Upstart uses machine learning to identify fraud by analyzing borrower behavior and transaction history. This proactive approach helps reduce fraud rates and protect lenders and borrowers (Upstart, 2021).

III. Pricing and Optimization

A. Optimization Using Financial Engineering:

Dynamic Pricing Models: Dynamic pricing models change interest rates and fees as market conditions, profiles of borrowers, and competitive issues arise in real-time so that they can appeal to the best clients while controlling risks (Campbell, 2006).

Portfolio Optimization: Financial engineers use optimization algorithms to balance the lending portfolio with low-risk and high-return loans that align with the lender's risk appetite and financial goals (Markowitz, 1952).

An Illustrative Case: SoFi uses financial engineering to offer individual profiled borrowers a competitive interest rate. In line with real-time data and market conditions, adjustments in its interest rates attract all sorts of borrowers, enabling SoFi to manage its risk exposure simultaneously (SoFi, 2021).

IV. Automated Underwriting and Decision Making

Automation of underwriting improves efficiency while ensuring consistency:

Automated Decision Engines: These are systems based on predetermined rules and algorithms for assessing loan applications, thereby minimizing the requirement for human intercession, speeding up the approval process, and reducing errors emanating from human beings (Mester, 1997).

Natural Language Processing (NLP): NLP techniques analyse unstructured data such as loan applications, emails, and customer interactions to extract relevant information and support decision-making (Manning et al., 2008).

Case Example: Kabbage uses automated underwriting to process loan applications in minutes. By integrating data from business accounts and other sources, Kabbage provides quick and efficient access to capital for small businesses (Kabbage, 2021).

V. Personalization and Customer Experience

Financial engineering also improves customer experience by:

Personalized Loan Offers: By analyzing customer data and preferences, lenders can tailor loan offers to meet individual needs, enhancing customer satisfaction and loyalty (Lemon & Verhoef, 2016).

User-Friendly Interfaces: Financial engineers design intuitive and user-friendly interfaces for online and mobile lending platforms, making it easier for customers to apply for and manage loans (Gao et al., 2015).

Case Example: Ant Financial's Sesame Credit uses big data to offer personalized loan products. The system analyzes a wide array of data, from e-commerce activity to social interactions, to provide tailored financial services to its users (Ant Financial, 2021).

2. Comparative Analysis: Modern vs. Traditional Lending Models

I. Enhanced Accuracy

Today, people use analytical and more advanced machinery in lending to enhance creditworthiness assessment. Traditional models, therefore, tend to use relatively few key variables as predictors of customers' creditworthiness, such as credit ratings and income. In contrast, modern models incorporate many diverse data sources and use complex techniques to evaluate the risk more effectively.

Example: Whereas conventional credit-scoring methodologies were likely to feature a borrower's credit history and income as score predictors, recent methodologies emphasize the borrower's real-time spending and social media activity and other non-financial data, which would result in better risk evaluation (Hurley & Adebayo, 2016; Petersen & Rajan, 2002).

II. Greater Inclusivity

Using alternative data, modern lending models discover a wider pool of credit candidates (scores), including candidates with poor or hardly any scores. It makes credit more readily available to various target groups, thus promoting the concept of financial inclusion and economic upliftment.

Example: Some FinTech organizations in emerging markets, including Tala and Branch, carry out credit ratings based on mobile data and offer credit to people without credit records. These companies can provide credit to millions of people who are still outside the formal finance system based on phone usage, payment records, and other digital trails (Bazarbash, 2019).

III. Real-Time Decision-Making

Standard credit procedures can be time-consuming and, many times, cumbersome; it takes days to weeks for credit to be granted. Current ways of lending allow for quick decision-making, which results in fast approval and a better experience for the borrower. These factors of speed and efficiency are good in competitive markets and for any borrower in need of funds.

Example: Since LendingClub and Prosper apply the principles of peer-to-peer lending, customers use its services through the Web and apply for credit without visiting the office, and credit decisions are made in minutes. They make use of big data and machine learning approaches to assess credit risk within a short period with a high level of accuracy.

IV. Operational Efficiency

Automation and optimization of loans minimize the costs and time used to process loans. The older forms of processing that imply manual underwriting are less effective and more likely to contain errors. Lending models in the current world have elaborated on the process by applying flexible automation.

Example: Automated systems in underwriting can process a high volume of applications quickly and of equal quality to manual evaluation, lowering operation costs. Kabbage is an online lending marketplace focusing on small business loans that do not require human underwriting. Instead, an automated system approves the applicant's loans within minutes.

V. Competitive Advantage

In conclusion, financial engineering utilizing contemporary techniques offers opportunities for gaining a competitive advantage through offering a superior deal coupled with an efficient and tailor-made service delivery system. The problem that traditional lenders may encounter in this facet is that they might lose market share to newer and leaner FinTech players.

Example: Startups such as Upstart and Affirm management report that they have snatched a competitive advantage because they offer different kinds of loans and have used data analytics to make better loans than their competitors. These companies utilize machine learning to assess a certain loan's credit risk, enabling them to charge lower interest rates and flexible loan terms compared to conventional lenders.

3. Challenges with Financial Engineering and Effective Mitigation Strategies

Although financial engineering has many advantages, it also poses some issues that must be solved before it can be applied to the lending business successfully.

I. Data Privacy and Security

Big data in lending has the problem of violating the privacy and data of the clients. Lenders also have to guarantee the protection of clients' information and obey the rules, such as GDPR and CCPA, in the context of the USA. The big volumes of data generated and processed can be an attractive point for attackers, which is why cybersecurity is paramount.

Mitigation: Other recommendations include the use of strong data encryption methods, using of multiple-factor authentication, and using security audits. A clear and comprehensible attitude towards data and receiving direct permission of the customer for data usage is critical for trust.

II. Model Transparency

Deep learning models, which are a subcategory of machine learning, are notorious for being difficult to interpret. Especially when it comes to the kinds of black-box models we have discussed in this paper, it is critical to make their functioning transparent and easy to explain to regulators and customers alike. Consumers also want to know the process through which different decisions are made so that they are reasonable and justifiable.

Mitigation: Prescriptive analysis and a detailed record of the model's decision can assist lenders in establishing that their models are fair and accurate. Another essential practice is that models should be regularly checked and updated to reflect the relative ethical framework.

III. Ethical Considerations

Ethical dilemmas arise from incorporating non-traditional data and digital decisions in the contemporary credit scoring approaches. FF&P is a vital goal that serves as a critical component in addressing fairness or lack of discrimination that is likely to spur social irresponsibility by lenders.

a) Potential Bias in Algorithms

In machine learning, the patterns in data are learned, and the algorithm itself reinforces or magnifies the biases in the data. An adverse impact on the affected population can present itself in failures to promote equity and replication of disclosed prejudice in the form of historical data.

Mitigation: Lenders need to have proper procedures to identify and reduce the biases in the models. This includes:

- Bias Audits: Anti-bias auditing; in this case, we will focus on creating structures and processes for checking algorithms to see if they are impaired with biases and, if yes, ways of eliminating them.

- Fairness Constraints: Fairness constraints are embedded during the model training process to achieve a fair model.

- Diverse Data: Enable accurate and diverse data sets to reduce the prospects of making biases related to identically similar data.

- Human Oversight: Incorporating human control and involvement in operations to identify and revert any bias effects.

b) Accountability in Automated Decisions

One of the main issues arising from using the AD tool arises from the position that borrowers are often affected by wrong or unjust decisions. There is a need to have accountability measures and, most importantly, legal justice for the aggrieved.

Mitigation: The learners shall develop means for borrowers to challenge or appeal to the automated decisions made. This includes:

• Appeal Mechanisms: Informing borrowers of their rights to appeal the decision and get their file checked by an actual person.

• Feedback Loops: Have feedback mechanisms through which borrowers can signal that they have been unfairly treated or that the models produce erroneous results and incorporate these into the successive round refinements.

Example: A lender using automated underwriting should provide a way through which a borrower can appeal the decision of rejecting his/her application so that they can be considered by an actual underwriter who can help in considering other factors that can come about.

c) Regulatory Compliance

It is important to note that liberal use of financial engineering techniques in an organization's line of credit must meet some regulatory standards that call for equity, fairness, efficiency, and accountability in lending, amongst other pertinent issues. This implies lenders must be acquainted with existing legal changes and work within the legal framework for models and processes.

i. Preparing for Future Regulations

The rules and regulations are dynamic since new ones are formulated to provide for new technological inventions and ways of processing data. It implies that lenders must be ready to regulate for changes to occur since non-compliance is not an option.

Mitigation: It is also vital for lenders to network with regulators and attend forums where new regulations are, according to this paper.

Example: A lender expecting strict rules to be placed on AI transparency immediately would prepare to construct explainable AI methods and paperwork well before the new rules' implementation.

ii. Ethical AI Governance

This then means that there is a need for ethical AI governance systems to be set, which can assist lenders in addressing the various causes of challenges in the use of this technology. This pertains to the formulation of ethical norms, proper regulation over the creation of artificial intelligence, and proper conduct by various institutions.

Mitigation: Formation of the ethical committee, engagement of the multi-stakeholder, and setting the tangible ethical frameworks may help promote the effective management of the AI system.

Example: A lender may set up an ethics committee over the AI models to maintain and implement the ethical quandaries in each process stage.

4. Future Directions and Innovations

The advancements in financial engineering in lending demonstrate that they are set to grow and advance even further. Emerging trends and potential developments include: Emerging trends and potential developments include:

I. Quantum Computing

Optimization problems can be solved at a very fast rate in quantum computing, and this can bring significant changes to financial engineering. This may result in better risk estimation, better Portfolio management and evaluation, and quicker calculation of big volumes of data.

Impact: Quantum computing algorithms could extend the speed of credit scoring models and the handling of large volumes of data, which would help lenders improve the models' efficacy. Though yet to be in its early stages, quantum computing proved to be a useful tool in lending in the future (Arute et al., 2019).

II. Explainable AI

Thus, there is a need for the so-called explainable artificial intelligence (XAI) when the number of regulatory requirements rises. XAI techniques are intended to improve ML models' ability to lend and enable the lender to explain the reasons behind the identified outcomes. This is true as it will help ensure compliance with the law and act as a way of proving reputation to its customers.

Impact: Valuable in explaining decision-making, incorporating XAI techniques will improve the understanding of lenders' choices to make them more transparent and, therefore, accountable. This will assist in responding to issues of bias and discrimination in automated lending (Doshi-Velez & Kim, 2017)

III. Personalized Financial Services

There are expectations that with the help of AI and analytics, there will be even further customization of financial services. The ability of lenders to provide clients with uniquely customized loan products tends to increase customer satisfaction and loyalty.

Impact: They will attract customers since personal lending solutions will address their personal loan needs and preferences. This will also help lenders enhance client interactions, resulting in high customer loyalty (Sarkar et al., 2020).

IV. Integration with IoT

IoT, for instance, can offer real-time information on borrowers' assets and their financial transactions to lenders. For instance, connected devices can keep track of the security of offered assets like vehicles or any mechanical equipment, which is beneficial for monitoring and credit administration for lenders.

Impact: The incorporation of IoT is expected to give more updated data on the status and value of the collateral, improving risk assessment. This will help lenders provide better credit and minimize the occurrences of defaults (Yan et al., 2019).

5. Conclusion

There is truth in the assertion that financial engineering has revolutionized credit lending since it leads to better, faster, and fairer credit provision services. Modern lending models mitigate traditional models' flaws, which would make them incapable of processing heavy, elaborate calculations as an important part of the credit risk assessment process and, consequently, would look disastrous, in one's opinion, for both lenders and borrowers.

The use of advanced instruments like artificial intelligence, big data, and blockchain has improved the existing features of financial engineering, including high precision in decision-making, risk administration, and personalization of services. Thus, analysing the modern trends in the financial industry, it can be stated that financial engineering will play a critical role in credit lending in the future.

Although data privacy issues, model interpretability, and regulatory compliance are significant barriers, the global financial engineering of credit has just begun. By adopting these innovations, lenders may efficiently strafe and remain relevant, attend to more customers' demands, and reduce the risks concurrently in the evolving financial markets.

Consequently, using financial engineering tools in contemporary lending approaches is based not only on the weaknesses of conventional forms of credit but also on the evolution of a viable, innovative, and flexible financial environment. In the foreseeable future, integrating this professionalism and the closeness between financing and technology will open new possibilities and create more plans for evolving the sphere of the financial sector. Thus, the future of lending can be achieved through financial engineering with advanced technologies such as machine learning, Big Data, and automation. While discussing data privacy issues, model

explainability, and concerns still waiting for regulators' attention, it is possible to conclude that financial engineering has the potential to bring an innovative shift to credit lending. Thus, the adoption of such innovations will help lenders maintain relevance and reach more clients, as well as mitigate risk in the constantly changing financial industry.

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Carbon Pricing and Carbon Markets

Utkarsh Majmudar

The last millennia have seen a huge transformation in our natural systems. The Stone Age hunting technology led to many mammals' extinction. Next came the agricultural revolutions that transformed forests into farmlands. The Industrial Revolution led to the most dramatic changes on Earth. The need for minerals led to the carving of the earth; the need for water led to the creation of dams and reservoirs that manipulated the flow of rivers; synthetic fertilizers led to the indiscriminate disruption of the nitrogen cycle. The worst impact was the restructuring of the global carbon cycle due to greenhouse gas (GHG) emissions at an unprecedented scale. The clearance of forests led to a reduction in the capacity of nature to absorb carbon. In contrast, industrialisation has led to homes being illuminated by a coal or natural gas-fired power plant. Every petroleum-powered train, plane, and motor vehicle has contributed to the net accumulation of carbon dioxide in the atmosphere.

The high levels of greenhouse gases in the atmosphere have led to climate change. While many attempts were made to achieve a global consensus (Rio Summit, Kyoto Protocol, etc.), the breakthrough came with the Paris Agreement in 2015, where countries agreed to limit temperature change to 1.5 degrees Celsius above the pre-industrial era. A key ingredient to achieving the target is to reduce greenhouse gas emissions. There are many ways to achieve this reduction. One is eliminating GHG emissions by shifting from fossil fuel to renewable energy. Another is to use technology to reduce GHG emissions. Governments are using economic intervention such as carbon pricing to move companies to adopt either of the two approaches.

In this article I explore the role of externalities in carbon pricing, mechanisms of estimating a carbon price, the carbon markets and its components and the benefits of carbon pricing.

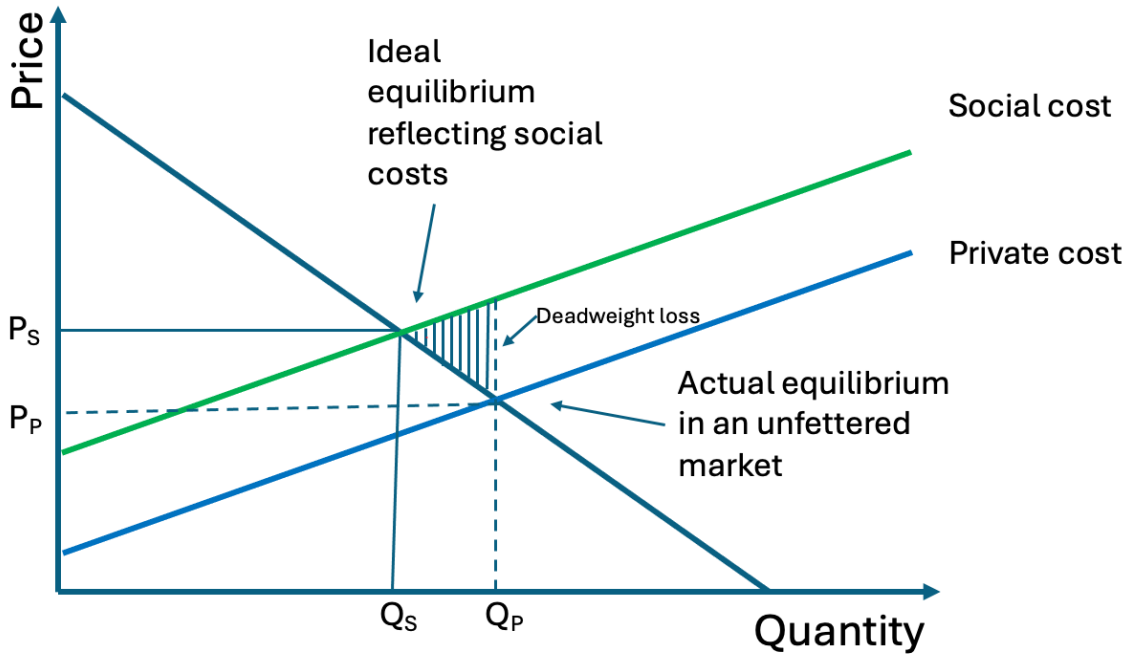
Externalities and Carbon pricing

An externality is a positive or negative outcome of a given economic activity that affects a third party that is not directly related to that activity.(What Is an Externality?, n.d.). Externality can be of two types – positive and negative. GHG emissions are a negative externality impacting people’s health and well-being.

In the case of GHG emissions, the polluter decides purely on the direct costs and the profit opportunity from production. She does not care about the indirect costs to those harmed by the pollution. The indirect costs include a higher cost of healthcare and reduced income due to illness caused by pollution. Since the polluter

does not bear the indirect costs, they are not passed on to the end-user of the product produced by the polluter. Thus, the social (or total) cost of production is higher than the private cost of production. The economics of this is described in Figure 1. The Figure shows the classic graph of supply and demand. There are two supply curves – the lower supply curve (in blue) incorporates only the direct costs (also called private costs) and the upper supply curve (in green) incorporates the direct as well as the indirect costs (social costs). Where only the direct/private costs are considered, price PP and quantity QP are obtained. After incorporating indirect/social costs, price PS and quantity QS are obtained. The optimal quantity for society (where demand and supply curves intersect) is QS; however, the real market equilibrium is at QP. The shaded triangle represents the deadweight loss – the economic value lost due to externality.

Figure 1: The Impact of Negative Externality



Source: Author

Externalities are an important cause of market failure. Market efficiency requires equal private and social returns. There is a gap between the two in the presence of an externality. Price intervention can help close the gap and restore equilibrium. Greenhouse gas emissions are a cause of externality.

Greenhouse gas emissions have increased from the pre-industrial era level of 278 parts per million (ppm) to 417 ppm in 2021 (Met Office, 2021). At the same time, global temperatures have risen by 1.1C. According to a study by the Institute of Policy Integrity, climate change could cost the world some $1.7 trillion a year by 2025, increasing to about $30 trillion a year by 2075 (Institute for Policy Integrity, 2021). This provides an impetus to account for the social cost of carbon (GHG) emissions, the difference between PS and PP in Figure 1.

Basics of Social Cost of Carbon

Governments have many policy options to curb carbon dioxide (CO2) emissions and slow global warming. There is a wide range of estimates of the costs that these policies will impose on governments and taxpayers. If the government doesn't do anything or does too little, society will inevitably pay the price.

The social cost of carbon (SCC) is the monetary value (say, dollars) of the economic damages resulting from emitting one additional ton of greenhouse gases into the atmosphere.

The social cost of carbon is a tool that helps policymakers determine whether the costs and benefits of a proposed policy to curb climate change are justified. A higher SCC generally means that the benefits of a particular climate policy to cut CO2 justify its cost; a low SCC makes a policy seemingly cost more than the benefits it ultimately delivers.

Estimating the dollar amount of SCC requires information that links social, economic and physical features into one framework. This information is then fed into computer models. These models integrate four types of information (Cho, 2021):

1. **Predict future emissions** based on population, economic growth, and other factors.
2. **Model future climate responses:** Future emissions are estimated and based on these estimates, the impact is assessed regarding increased temperature and sea-level rise.
3. **Assess the benefits and costs:** What will be the impact of climate change on agriculture? What will be the cost of adaptation to sea level rises? What will be the impact of additional warming on energy use? What will be the impact on worker's productivity?
4. **Convert to present value:** Since benefits and costs will likely accrue over time, policy decisions must be made today. Hence you discount the future costs and benefits to today. At what discount rate? It is the discount rate that indicates a willingness to spend today to protect future generations.

Simulation of the three models is run hundreds of thousands of times using different values for uncertain variables and parameters. As a result, many estimates of SCC emerge. SCC is usually represented as a range rather than a single number. An average of all the estimates is taken at a particular discount rate to deliver a representative SCC. A representative computation is shown below:

We can get a sense of SCC by seeing that it was estimated that India's country-level social cost of carbon emission is the highest at $86 per tonne of CO2 in the world (Ricke et al., 2018). This means the Indian economy will lose $86 by emitting each additional tonne of CO2. Next in scale is the US, where the economic damages would be $48 per tonne of CO2 emission and Saudi Arabia at $47 per tonne of CO2 emission.

Carbon Markets

While estimates of the social cost of carbon help companies price their products there are other mechanisms that will help companies manage their emissions. Carbon markets are one of the tools to tackle the climate change problem. The climate change problem is simply the accumulation of greenhouse gases in the atmosphere. Given that there is only one atmosphere, it matters little where the emissions are released. The emissions will soon spread around the earth, creating what is known as the greenhouse effect28. Going by this logic, if a group of people, countries or companies can agree to limit their emissions to a certain amount (a "carbon budget"), it does not matter how much each person emits or where they do so, as long as the whole group does not emit more than what they committed to. Since it doesn't matter where we reduce emissions, the argument behind carbon trading is that the best way to take climate action is to reduce emissions where it is easiest (i.e. least costly).

To achieve emission reductions, governments around the world have established carbon markets. Here, emissions (or emissions reductions) can be exchanged from one entity to another. In theory, as long as we control the total amount of emissions traded in the market, it does not matter for the climate who buys or sells. Although this works well in theory, in practice, establishing a global or even a national carbon market is fraught with significant challenges. Significant risks are present in the system. Loopholes in the system can result in the policy having little or no impact.

There are two types of carbon markets -- regulatory compliance and voluntary.

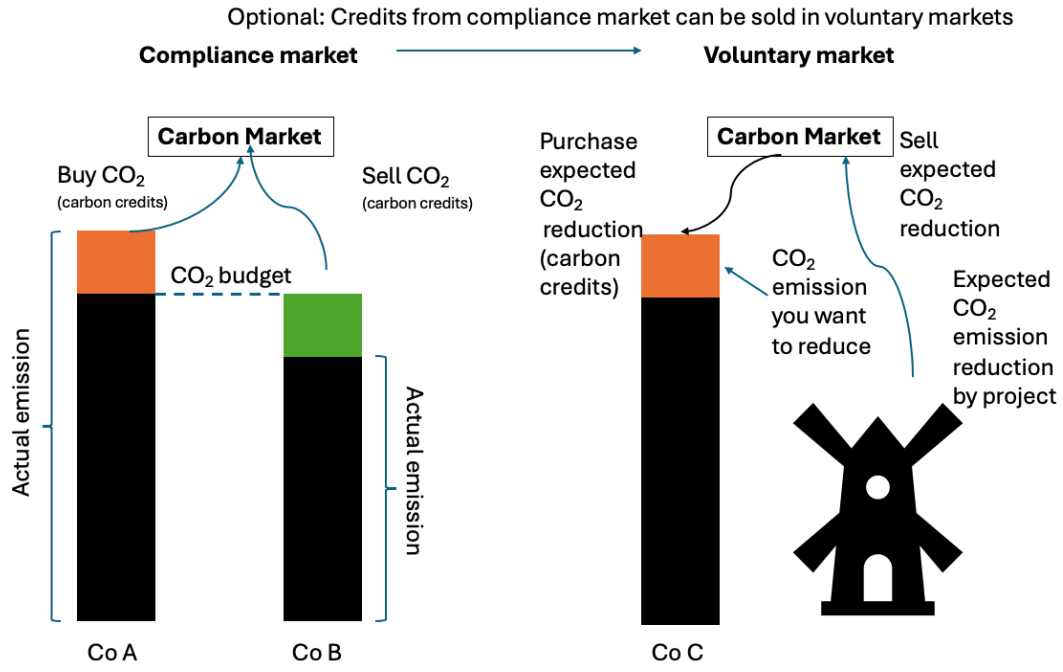
(a) The compliance market is used by companies and governments that, by law, have to account for their GHG emissions. Mandatory national, regional or international carbon reduction regimes regulate it. 218 shift

[28] The greenhouse effect is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without this atmosphere.

(b) The voluntary carbon market is a decentralized market where private actors voluntarily buy and sell carbon credits representing certified removals or reductions of greenhouse gases (GHGs) in the atmosphere.

The operation of compliance and voluntary carbon markets is illustrated in Figure 2.

Figure 2: Compliance and Voluntary Carbon Markets



Source: Adapted from Carbonable.io, 2024

According to the Carbon Pricing Dashboard (Carbon Pricing Dashboard, n.d.), 110 carbon pricing initiatives have been implemented or are scheduled to be implemented in 53 national jurisdictions. In 2024, these initiatives would cover 12.8 GtCO2e29, representing 24% of global GHG emissions.

There are various types of carbon pricing mechanisms (What Is Carbon Pricing?, 2017).

An emissions trading system (ETS) is a system where emitters can trade emission units to meet their emission targets. Companies can consider either internal abatement measures or acquire emission units in the carbon markets to meet the emission requirements. Thus, those with excess carbon units can trade them in the carbon markets with those unable to meet their emission requirements. The ETS market creates a demand and

[29] Gigaton Gigaton Carbon dioxide equivalent.

supply for emission units through a trading mechanism establishing a market price for GHG emissions. There are two main types of ETSs -- a cap-and-trade and baseline-and-credit.

Cap-and-trade systems: A cap-and-trade program limits the total amount of CO_2 that can be emitted by certain facilities. In this system or program, the government issues a limited number of emissions allowances (permits). Each of these permits grants the holder the right to emit one ton of CO_2. These allowances are tradeable. The sale and purchase of the allowances yield a market price for the allowance. This is practically the price of one ton of CO2.

Baseline-and-credit systems: Here baseline emissions levels are specified for individual companies. Credits are issued to companies that reduce their emissions below the baseline emissions. These credits can be sold to other companies that have exceeded their baseline emission levels.

Banking and borrowing caps: Some cap-and-trade programs include provisions for the banking and borrowing of allowances over time. Thus a permits issued in one year can be submitted to account for emissions in later years (this is like putting money in the bank). Alternatively, permits for future years can be issued and used in the current year (one is borrowing permits today, which would have been used in the future).

A **carbon tax** is a price set per ton of carbon per ton of CO_2 emitted. CO_2 emissions from the combustion of fossil fuels are proportional to the carbon content of the fossil fuel. Thus the carbon tax is effectively a tax on CO_2. Given that carbon constitutes approximately 3/11th weight of CO2. A $1 tax per ton of CO_2 equals a $3.7 tax per ton of carbon.

An **offset mechanism** designates the GHG emission reductions from project- or program-based activities. These emission reductions can then be sold either domestically or internationally. Often a registry a created for the issue of carbon credits. . These credits can, then, be used to meet compliance requirements.

Internal carbon pricing is a mechanism organizations use in their internal decision-making process to value change impacts and their risks and opportunities.

Result-based Climate Finance (RBCF) is a funding approach where payments are made after pre-defined outputs or outcomes related to managing climate change are met and outcomes like emission reductions are achieved and verified. In many RBCF programmes, verified GHG reductions are purchased, creating a carbon market.

Carbon Border Adjustment Mechanism (CBAM): This is a variation of the carbon tax. Initiated by the EU recently it aims to address the problem of carbon leakage. Carbon leakage occurs when companies outsource their manufacturing to countries with relatively weaker emission norms. The tax will enable the EU to match the carbon price of imports with that of domestic goods. It is intended to provide a level playing field and improve the decarbonisation of industries.

Carbon taxes and cap-and-trade programs differ on the type of certainty they provide. Carbon taxes are certain as companies know how much they will need to pay per ton of carbon they emit. At the same time, it allows companies to get away by paying money. On the other hand, cap and trade programs ensure quantitative reduction in emissions. Unfortunately, the price fluctuations in trading markets make it difficult for businesses to make decisions. Building in cap and floor features in cap-and-trade programs reduces price volatility. Carbon taxes can also be designed to adjust dynamically if actual emissions miss the predetermined emissions path.

Benefits of Carbon Pricing

Carbon pricing policies have several features that make them more efficient or less costly than other policies to reduce carbon dioxide emissions (such as technology mandates, direct regulations, subsidies to zero-carbon energy sources, etc.). These features are:

Flexibility: Carbon pricing mechanism allows companies to choose the method or technology to reduce or mitigate emissions. This is unlike technology mandates where the regulator decides on a single method that is then applied to a wide set of companies. This one size fits all may make it prohibitively expensive for some companies when cheaper methods of emission reduction exist.

Equal Marginal Costs of Abatement[30]: An economy-wide carbon price applies a uniform price on CO_2 emissions regardless of the source. This results in the equalisation of marginal abatement costs across firms and sectors. Regulations, on the other hand, imply different marginal abatement costs across firms and sectors. Thus regulations in sectors with very high marginal abatement costs may require that regulation be removed (as it sis cost-ineffective). At the same time, it will lead to more stringent regulations in cases of low marginal abatement costs. Undertaking such balancing acts are difficult for regulators – something that carbon pricing does effectively.

[30] Abatement cost is the cost of reducing negative externalities like pollution. The marginal cost of abatement measures the cost of reducing one more unit of pollution.

Encouraging Conservation: Conventional regulations put a limit of emissions per unit of output. This leaves little incentive for companies to undertake reductions if they are meeting the regulatory requirements. In contrast, carbon pricing provides incentives to reduce emissions per unit of output, but also charges a price for every additional ton of CO_2 that is not reduced through increased efficiency. With carbon pricing, costs can increase for high emitters as it charges a price for every additional unit of CO2 that is not reduced through increased efficiency. This motivates companies to improve their carbon efficiency.

Revenue: A carbon price creates a new revenue stream (for example, money earned by selling carbon credits) that can be used in a number of ways.

Carbon Pricing Design: There are many elements that go into the design of carbon pricing instrument.

Price: Economic theory suggests that the maximum benefits if carbon pricing accrue when carbon price is equal to marginal cost of abatement. This can be achieved by either setting a carbon tax equal to marginal damage31 or by capping emissions at a level equal to marginal damage.

Stringency: A $50 carbon tax is said to be more stringent than a $5 carbon tax. The more stringent tax it will lead to lower emissions and higher costs. In determining stringency, policymakers face a trade-off between environmental goals and the costs of meeting those goals.

Coverage: The coverage of a carbon pricing policy indicates which sectors and industries or emission types will be covered under carbon price. Take the case of the European Union Emissions Trading System cap-and-trade program. It covers emissions of CO_2, nitrous oxide (N_2O), and perfluorocarbons (PFCs). Also covered are 11,000 energy intensive plants in electric power and manufacturing sectors that emit these emissions. These are spread over 31 European countries.

Point of Regulation: The point of regulation of a carbon price determines who is required to submit permits or pay the tax to the government. For instance, an upstream carbon tax would tax fossil fuel producers for the carbon content of their products. A midstream tax would tax the first purchaser in the supply chain of fossil fuels (say, a refinery) for the purchase of crude oil. A downstream tax applies to the emitter. For example, the coal-based power plan will pay for the emissions.

Revenue Use: Carbon revenue can be used in multiple ways. For instance, a carbon dividend can be distributed to households. Tax swaps can also use the revenue from a carbon price to reduce taxes. Carbon pricing revenue can also finance green spending programs, which aim to reduce emissions through non-pricing methods. Another option is to reduce the government's budget deficit.

[31] damage caused by adding one additional ton of carbon dioxide into the atmosphere. This marginal damage is often called the social cost of carbon (SCC).

Carbon markets are a good mechanism to help companies reduce or maintain their carbon emissions below a threshold. While important, they are not a substitute for effort in emission reduction. To achieve the goals of the Paris summit, there is no substitute for speedy and significant carbon emissions reduction.

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