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FACULTY ADVISOR'S NOTE

The Economics Society has long been a trailblazer in facilitating meaningful and holistic discourse on topics encompassing economics, policy, finance, business, and more. Rooted in research and policy, the society transcends traditional boundaries of learning, equipping students with essential life skills through its diverse operations. From running a DataLab to fostering collaborations with the brightest minds in the country, the society has transformed into an organization that upholds the highest standards of professionalism and research rigour. With each passing year, they have reached new heights, embracing a heterodox approach that epitomizes the true spirit of a liberal arts education. It is within this spirit of innovation and evolution that we proudly present the Artha 2023.

Artha stands as a conscientious endeavour to foster independent research initiatives among undergraduate students, transcending the boundaries of economics to embrace the interconnections with other disciplines. It serves as a platform that employs rigorous analytical tools to shed light on the intricate relationships between economics and various fields of study. It is through the power of the written word that we believe education can inspire, influence, and enlighten. As the Faculty Advisor, I wholeheartedly commend the Economics Society for curating Artha, annual publication that addresses pressing economicissues and nuances through a collection of research papers and articles. The society's commitment to stimulating discourse and presenting diverse perspectives on contemporary matters is truly commendable. I extend my best wishes to The Economics Society.

Dr. Rajeev Kumar
Faculty Advisor

EDITORS' NOTE

It is with great pride and honour that we unveil the latest edition of Artha, our esteemed Annual Journal. As a hallmark of intellectual distinction, Artha represents our unwavering commitment to fostering independent research initiatives among undergraduate students. With its remarkable collection of scholarly contributions, Artha serves as a dynamic convergence of ideas, illuminating the intricate intersections between economics and a myriad of disciplines.

In a world often constrained by conformity, Artha stands as a beacon of intellectual curiosity and critical inquiry. It provides a platform to academia to materialise their ideas and present them to the world. With unwavering determination, this journal provides young researchers with an invaluable opportunity to question prevailing norms, offer insightful critiques and embark on daring explorations of uncharted intellectual territory.

Artha encapsulates the transformative power of the written word. We firmly believe in its capacity to educate, influence, and inspire. Through meticulous research and eloquent expression, Artha holds the potential to shape perspectives, challenge prevailing paradigms, and contribute to the broader discourse surrounding economic, social, and political systems.

Artha embodies our profound belief that education acts as a catalyst for building tolerance, mending societal divisions, and striving for harmony. As you peruse the pages of this prestigious journal, it is our earnest hope that it ignites within you a deep desire to comprehensively understand the complex dynamics that shape our world, combining quantitative rigor with qualitative insights.

Pakhi Vats and Imnasangla Jamir

Senior Editors
Chhavi Agrawal
Priyanshu
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Women Employment and their Empowerment: The Case of South Asia

Annie Shrestha, Md Hossain Uz Zaman, Thathsarani Siriwardana, Ishwari Sonavane, Ali Hassan, Mohammed Hanif Arghusshi

Abstract

This study uses demographic and health surveys to identify the relationship between women's employment characteristics and their empowerment indicated by their decision-making power, freedom of movement, control over resources, degree of sexual autonomy, and perception of domestic violence in Afghanistan, Bangladesh, India, Nepal, and Pakistan. The indicators of empowerment were used to create empowerment indices. The ordered logistic regression model was used to predict the association between employment and women's empowerment indices. The results show that women who are employed and are working in the formal sector have a higher likelihood of being empowered but women working for family members have a lower likelihood of being empowered. Education and residence in urban areas have better empowerment outcomes but the level of wealth, whether women practice the major religion of their country, and have at least one child under five impact women's empowerment differently across countries. A variety of robustness checks and comparisons with the literature corroborate the results. Based on the results, this paper delineates policy suggestions that need to be implemented to reduce the gender gap in each country.

Introduction

The latest Global Gender Gap Index, released by the World Economic Forum, reveals that achieving full gender parity worldwide will require an average of 130 years. The South Asian region is projected to close the gender gap in 197 years, performing abysmally among the eight studied regions (World Economic Forum, 2022). The crisis of gender inequality is also aptly reflected in the problem of missing women (Sen, 2002). In India alone, approximately 45 million women were reported missing in 2020. South Asia is a region characterized by a preference for sons, leading to issues such as sex-selective abortion, female infanticide, and neglect of girl-child (Abrejo et al., 2009).

Women adopt different strategies to survive in the deeply ingrained patriarchal setting in South Asia. South Asia's patriarchal structure goes by the moniker "classic patriarchy" where women typically do not have any claim on their father's patrimony in Kandiyoti's paper (1998). In such structures, younger women, especially daughters-in-law, face subordination not only by the senior male members but also by elder women, such as their mothers-in-law. Women's subordination in the younger phases of their lives is offset by the authority they gain as mothers-in-law. Sons are women's most crucial resource in the long-term and claiming their primary allegiance against the son's wives becomes their priority. Women in such environments cannot claim economic rights for fear of losing the support of male members. In Muslim communities, women who assert their inheritance rights are exposed to the risk of losing their favour with their brothers in case of conflicts with their husbands. Women who manage to work outside the domestic sphere often encounter labour segmentation in the job market, leading to limited opportunities and low wages. Women do not break out of this structure because, as Kabeer (1999) explains using the concept of Doxa, everyone in the society is under the impression that society's structure is unalterable.

The concatenation of these woes tells a well-known story about the lack of women empowerment around the world. Interest in women's empowerment picked up steam since the International Conference on Population and Development 1994 (UNFPA, 1993) which adopted the Program of Action that gave

women autonomy over their reproductive health, removal of violence against women, and participation of women in national and international platforms of imminent importance. Moreover, ever since the Beijing Declaration in 1995 committed the world to enhance the 'advancement and empowerment of women all over the world', South Asian countries have implemented programs and interventions which have made a positive impact on women's material conditions, improved education, and reduced risk of maternal mortality.

However, there is an extensive debate in the literature on the effectiveness of such interventions to empower women. While resources like micro-credit and employment opportunities play a crucial role in contributing to strengthening women's empowerment, they are not sufficient interventions as empowerment is contingent on the historical context, the calibre, and commitment of people who deliver such incentives, argues Kabeer (2005). Historically, developmental policies have had a misalignment of intention and action to empower women through access to economic resources. Based on the presumption of the nature of women's work, women received welfare-oriented rather than production-oriented economic training from international organizations and NGOs. Mayra Burnic documents the experience of a rural development project which intended to improve herd management and shear practices of highland farmers. Upon knowing that women were responsible for herding and shearing wool, the project was redirected to train women instead in knitting, cooking, and embroidery. Several other studies have documented such redirection of project goals (Mehra, 1997).

Today, empowering women has been synonymous with fitting the neo-liberal development agenda to exploit women's cheap labour (Nazneen et al., 2019). Women's employment is mostly concentrated in agriculture and informal sectors that do not offer significant job benefits and social protection. Najeeb, Fatima; Morales et al. (2020) examine female labour force participation among South Asian countries. They find that from 2001 onwards, women's labour participation in the region has been low and remained unchanged, the middle age bracket shows clear gender employment gaps, rural female employment is higher than in urban areas, a higher share of

employment is accounted by agriculture economic sector and women with mid-level education tend to have lower employment rates compared to both higher and lower education levels. We intend to demonstrate the relationship between women's employment and empowerment in Afghanistan, Bangladesh, India, Nepal, and Pakistan. To the best of our knowledge, there are no studies that make a comparative study of women's empowerment across countries in South Asia. Women in South Asia are largely employed in the agricultural sector and are subject to stringent patriarchal norms. Given these similarities, it will be interesting to observe if the determinants of empowerment are different for these countries. Furthermore, this study adds substance to the literature by delving deeper into the association of women's employment characteristics (occupation and employer type) in addition to working status with their empowerment. This will allow policymakers to understand where their effort can be maximized to enhance women's empowerment in the best way possible. The rest of the paper is structured as follows: Section 2 explains the theoretical framework, Section 3 entails the literature review, Section 4 explains the methodology, Section 5 reports the findings of this paper along with the analysis, and Section 6 explains the conclusions and offers policy suggestions.

Theoretical Framework

2.1 Definitions of Empowerment

Researchers and different institutions have adopted a range of definitions of and approaches to understanding empowerment. Most of the definitions converge to an agreement that an individual's empowerment entails at least the exercise of control to enhance their livelihood. The literature is rife with words like control (Jejeebhoy Sathar, 2001), power (Agarwal, 1997) agency, autonomy (Dyson Moore, 1983), and bargaining power (Beegle et al., 2001) which in essence allude to women's ability to make decisions for themselves and their family members and are relevant in the discussion of empowerment.

The World Bank identifies empowerment as a key element to alleviating poverty and defines it as the "expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control,

and hold accountable institutions that affect their lives."

UNICEF (2018) says that empowerment is about women, men, girls, and boys taking control over their lives: setting their agendas, developing skills (including life skills), building self-confidence, solving problems, and developing self-reliance. The process of empowerment enables women, men, girls, and boys to question existing inequalities as well as act for change. Among other frameworks, UNICEF has identified and used the Women Empowerment Framework developed by Sara Longwe which argues that poverty reduction requires the empowerment of women. The framework lists five degrees of empowerment in progressing levels of importance: welfare (income, food, health care), access (equality of access to land, education, credit, etc), conscientization (awareness of rights, gendered roles, and divisions of labour, participation in decision making (in formal and non-formal bodies), and control over decision making. The United Nations Development Fund for Women defines women's empowerment 'as having access to and control over the means to make a living on a sustainable and long-term basis and receiving the material benefits of this access and control. These definitions encompass both the short-term goal like building skills and long-term goals of empowerment like looking at sustainable changes in households, communities, and laws to provide an enabling environment for women to make independent choices.

Scholars have viewed empowerment as a process or an outcome or both. Naila Kabeer views empowerment as a "process of change" that entails exercising consequential choices given that the decision-maker can choose among other alternatives. The ability to make choices has three dimensions: resources, agency, and achievement. Resources include material resources and social relationships which enhance the decision-maker's ability to exercise choice. Agency implies the ability of the individual to set goals for themselves and pursue them. Achievements of the decision-maker can range from the individual's fulfilment of necessities to their representation in political space depending upon the context. Bennet (2002) defines empowerment as a process of "the enhancement of assets and capabilities of diverse individuals and groups to

engage, influence, and hold accountable the institutions which affect them."

Dixon-Mueller (1993) defines empowerment as "both a group and an individual attribute; a process (that of gaining power) and a condition (that of being empowered)." Along the lines of encapsulating both the dimensions of empowerment (process and outcome), Batliwala (2007) says that "women's empowerment is thus the process, and the outcome of the process, by which women gain greater control over the material and intellectual resources, and challenge the ideology of patriarchy and the gender-based discrimination against women in all the institutions and structures of society". Batliwala (2007) has also emphasized on "empowerment spiral" in addition to grassroots level initiations to galvanize macro level transformative political action. Malhotra et al. (2002) point out that empowerment frameworks identify several unique dimensions, suggesting that empowerment must occur along economic, socio-cultural, familial/interpersonal, legal, political, and psychological lines.

2.2 Employment and Empowerment

In game-theoretic bargaining models in economics, partners in a relationship can increase consumption by cooperating and choosing an allocation that would benefit both of them. In case partners have conflicting preferences, the resources available will be distributed through a process of bargaining. The bargaining power of an individual depends on the utility level they can attain in the absence of cooperation, which is referred to as a "fallback position" which can take the forms of employment opportunities, child support, property rights, etc. This model implies that we can enhance the bargaining power of an individual in a relationship by improving their conditions outside the marriage (A. Seiz, 1994). In sociology, resource theory states that access to personal (which the individual has direct control over) and social (which is available to the person through direct and indirect relationships) resources enhances the socioeconomic status of the individual (Lin, 1999). Resources include not only material assets in the conventional sense but also human and social resources that help individuals uplift their socioeconomic status (Kabeer, 1999). For instance, for someone with a rich social circle, it's

the ability to make choices in different settings like the home, market, and society (Sharaunga et al., 2016). According to Sen (1985), resources and agency determine the capabilities of individuals to live as they want. The concept of simple access to resources empowers individuals has been contested by theorists. Mizan (1992) argues that factors like the ability to make decisions, intentionality and effectiveness of exercised power, control outcomes, power exertion processes, and the presence of conflict are left out by the theory (Mizan, 1992). Pearson (2004) argues that employment does not relieve the burden of domestic labour, increase political participation, or lead to equal property rights. Kabeer (1997) explains that women, even if they might have access to resources, may not use them to bargain for their preferences and instead compromise in the relationship due to the pressure to conform to societal norms. Batliwala (2007) points out that empowerment is not necessarily an outcome of economic ability as employed and rich women are also subject to violence. Thus, there is a difference between women having access to resources and having control over those resources (Kabeer, 1999). Given that there is a schism in the literature regarding resource theory, this paper aims to test resource theory using employment as the main resource to see its impact on women's empowerment.

Literature Review

Acharya and Bennet (1983) find that the entrance of women into the market economy positively affects their influence on resource allocation and domestic decision-making. Abrar ul Haq et al. (2019) have also identified a significant positive relationship between women's employment and empowerment. Basu and Koolwal (2005) use 1998-1999 NFHS-2 data for India to show that women associated with positive socioeconomic outcomes like earning income levels, belonging to upper-caste, and whose partners are educated have the ability to indulge in freely listening to the radio, reading the newspaper, going to the market, and setting aside money for themselves.

Kantor (2003) concludes that increased income alone is not sufficient to directly facilitate women's iempowerment within the household. For women involved in home-based production in the garment sector in Ahmedabad, control over income decreases when their income increases. Similarly, Malhotra and Mather (1997) conclude that employment is not a sufficient factor to determine the empowerment of women. Rather, the nature of work matters, and the historical and developmental context of the society matters. Employment helps women gain participation in decision-making at the household and social levels however the finding indicates that employed women's control of their resources is limited. However, while women have control over their bank accounts, savings and valuables (jewellery), they have negligible control and ownership of the property.

West (2006) used 1998-1999 Demographic Health Survey (DHS) data for India to look at the connections between employment status, occupation, employment characteristics and women's empowerment in terms of decision-making, freedom of movement, control over resources, and views on violence against women. The study has used categorical data analysis to measure the relationship between employment and empowerment. A combination of logit models is used to determine the odds ratios of having a higher level of empowerment across various socio-demographic and employment measures. Agricultural workers and women who did not work at all were the least likely to be empowered in all of the indicators. Interestingly, employed women were more likely than unemployed women to report that it was justifiable for their husbands to hit them. Roy and Niranjan's (2004) study found that being engaged in employment for cash increases women's autonomy, but that education is more important, and direct measures of autonomy are positively related to empowerment outcomes and more closely related than indirect measures of empowerment.

Kabeer et al., 2018 use a combination of survey data and qualitative interviews to explore the relationship between the work patterns and indicators of empowerment in terms of control over earnings, intra-household decision-making, freedom of movement, participation in public life, and perception of their own empowerment in Bangladesh. They conclude that women employed in paid work has higher levels of agency than other categories of women in areas like making independent decisions about their health, supporting

their natal family, and knowing about labour laws. However, these women are also subject to harassment and abuse in their work environment. Women working in garment factories in Bangladesh in Kabeer's research gave away their income to their husbands in deference to the cultural norm of the male as the head of the house. While men could freely spend money on indulgences they personally preferred, women substantially spent on children's education, which most women used as a pretext to get the job in the first place, and regular household expenditure. Some women reported their wages lower than the actual amount to their husbands to set up savings accounts clandestinely and yield some economic autonomy from their earnings.

4.1 Data

This study uses Demographic and Health Surveys (DHS) for Afghanistan, Bangladesh, India, Nepal, and Pakistan. DHS is a nationally representative population-based survey with a large sample size and is funded by the United States Agency for International Development (USAID). The survey includes information on women's socio-demographic characteristics, employment characteristics, decision-making abilities, control over resources (earnings), control over sexual activities, perception of domestic violence, and freedom of movement. We included the DHS years for all countries closest to each other to make the analyses comparable across countries. The DHS equivalent in India is the National Family Health Survey (NFHS). The following DHS surveys were used for the listed countries: 2015 for Afghanistan, 2017 for Bangladesh, 2015 for India, 2016 for Nepal, and 2017 for Pakistan. The final sample size of married women aged 15-24 years used for our analyses was 7,77,294.

4.2 Variables

Drawing from the extant literature, this study uses information on women's decision-making, freedom of movement, control over resources, sexual autonomy, and perception of domestic violence as indicators of women's empowerment and their relationship with women's employment represented by women's working status, occupation and whom they work for.

4.2.1 Explanatory Variables

This study expands the definition of employment to scrutinize the deeper relationship between employment and empowerment. We first look at the "working status" of women to test the assumption of whether working enhances women's empowerment.

If working does empower women we look at the characteristics of the working status to determine how empowerment takes place among employed women. The characteristics of empowerment we take are occupation classifications: professional/technical/managerial (Professional), clerical/sales/services (Sales), household/domestic (Domestic), manual labour, and agriculture. Further, we included whom the respondent works for (family, someone else, self-employed) as another one of employment characteristics. Tables 1, 2, and 3 show the frequencies of women in our sample by their working status, occupation, and employer.

Table 1: Frequencies of Women by their Working Status (in %)

Variables	Afghanistan	Bangladesh	India	Nepal	Pakistan
Working	13.14	50.38	30.41	58.63	13.75
Not Working	86.86	49.62	69.59	41.37	86.25

Table 2: Frequencies of Women by their Occupation (in %)

Occupation	Afghanistan	Bangladesh	India	Nepal	Pakistan
Professional/Technical/Managerial	35.88	4.35	9.66	4.88	22.15
Sales and Services	1.38	11.3	17.73	13.63	16.26
Agriculture	36.11	64.42	51.57	73.19	22.15
Manual	26.62	15.77	21.04	8.18	39.45
Household and Domestic		4.16			

Table 3: Frequencies of Women by their Employer (in %)

Employer	Afghanistan	Bangladesh	India	Nepal	Pakistan
Works for family	66.79	56.27	75.06	71.64	27.5
Self-employed	17.52	21.06	13.35	12.46	28.19
Works for someone else	15.69	22.68	11.59	15.89	44.31

4.2.2 Covariates: Socio-Demographic Characteristics

Following our literature research, our analysis controls for a few key socio-demographic characteristics of the respondents. Education level is broken down into no education, primary school, secondary school, and higher school. Whether a

respondent resides in an urban or rural area is an important socio-demographic characteristic as are their age and religion. We categorized religion as "major religion" and "others" to see if women's association with the major religion followed in each country enhanced their empowerment. The major religions practised in Nepal and India are Hinduism and in Afghanistan, Bangladesh and Bangladesh, it's Islam. However, data on the proportion of the population which follows the majority religion versus minority religion is unavailable for Afghanistan and Pakistan because Islam is the official religion of both the countries and over 95% of the citizens are Muslim. We also include a measure of the household head's sex. We combined the poorest and poor categories to make a final category poor and rich and richer categories to make a final category rich in the wealth index.

Table 4: Socio-Demographic Characteristics of the Women in the Sample (in %)

Variable	Nepal	Bangladesh	India	Pakistan	Afghanistan
Type of Place of `Residence	(n=12,862)	(n=20,217)	(n=699,686)	(n= 15,068)	(n=29,461)
Urban	64.37	36.64	29.26	48.14	23.85
Rural	35.63	63.36	70.74	51.86	76.15
Education Level	(n=12,862)	(n=20,217)	(n=699,686)	(n= 15,068)	(n=29,461)
No education	33.79	15.91	28.09	50.62	85.54
Primary	16.18	31.5	12.62	13.96	6.71
Secondary	36.04	38.58	47.87	20.79	6.06
Higher	13.99	14.02	11.42	14.64	1.68
Age	(n=12,862)	(n=20,217)	(n=699,686)	(n=15,068)	(n=29,461)
15 -19	20.39	9.69	17.85	4.83	6.21
20 -24	17.93	17.46	17.57	14.73	20.65
25 -29	16.28	17.75	16.45	20.88	21.88
30 -34	13.91	17.2	13.87	18.93	15.21
35 - 39	12.32	14.67	12.92	18.17	14.61
40 - 44	10.39	11.57	10.95	12.09	10.83
45 - 49	8.79	11.66	10.39	10.37	10.61
Religion		(n=20,217)	(n=699,686)	(n=15,068)	
Majority		90.11	74.22	87.06	
Non- Majority		9.89	25.78	12.94	
Wealth Index Combined	(n=12,862)	(n=20,217)	(n=699,686)	(n=15,068)	(n=29,461)
Poor	42.24	38.05	40.4	40.66	42.1
Middle	20.21	19.29	21.03	19.68	21.57
Rich	37.54	42.65	38.56	39.66	36.32

4.2.3 Indicators of Empowerment and Empowerment Index

i) Decision-making

Decision-making is measured by two questions asking who decides on the respondent's health care and major household purchases. Response categories for these questions were recoded 0 if the decision maker is "husband or others" and 1 if "respondent alone or jointly with partner". A final decision-making variable was constructed by finding the average of the responses to the questions which resulted in a dichotomous decision-making variable with numerical codes 0 and 1.

ii) Freedom of movement

Freedom of movement was measured by the questions asking if the respondent needed permission to visit their family and relatives. The response for this variable was recoded as 0 if the response was "yes" and 1 if the response was "no".

iii) Control over resources

Questions that most aptly represented financial autonomy were who decided the control over the respondent's earnings and if the respondents had a financial account. Responses to the question regarding control over earnings were recorded as 0 if the decision maker is "husband or others" and 1 if "respondent alone or jointly with partner". Response to the question about the financial account was recorded as 0 if they did not have an account and 1 if they did.

iv) Views on violence against women

A variable of views on violence against women was constructed by combining six questions that asked respondents if it was justifiable for the husband to beat their wife if the wife went out without telling, neglected the children, argued with the husband, refused to have sex with husband, and burnt the food. The response is recorded as 0 if the woman reports that violence against wives is acceptable in one or more situations. Having a record of 1, and therefore saying that wife-beating is never okay, is associated with empowerment.

v) Sexual autonomy

The final indicator of empowerment, control over sexual autonomy, was measured by questions asking

if respondents could refuse sex and ask their partner to use contraceptive devices. Like the decision-making variable, the final sexual autonomy variable was constructed by finding the average of the two questions. After all of the indicators were constructed as binary variables, they were labelled "not empowered" and "better empowered" if the outcome was 0 and 1, respectively.

4.2.4 Construction of Empowerment Index

Because empowerment is multidimensional in nature, it is important to be careful when constructing an empowerment index. An inappropriate combination of indicators can hide the differential impact of individual variables on the outcome of interest (Malhotra, 2005). Since our indicators collectively reflect women's ability to make decisions in various aspects of their lives, we can confidently create an empowerment index. Initially, we calculated the mean score of women's responses, represented as either 1 or 0. Then, we determined the 33rd and 66th percentiles of the index for each country, transforming it into an ordinal variable. Women in the 33rd percentile were categorized as less empowered, those between the 33rd and 66th percentile were labelled partially empowered, and those beyond the 66th percentile were labelled highly empowered.

The frequency of the empowerment index across all countries is illustrated in Figure 1. Afghanistan, Bangladesh, India, and Nepal have more than 30 per cent of respondents categorized as not empowered. Among these countries, Bangladesh has the highest proportion of respondents falling into the better-empowered category, while Nepal has the highest proportion falling into the not-empowered category. In Pakistan, the majority of respondents are concentrated in the partially empowered category, comprising about 40 per cent.

Additionally, we constructed a sum index with a score ranging from 0 to 8 to verify the robustness of the results obtained from the main average ordinal empowerment index. The thresholds for the additional level of empowerment in this index were also computed using the 33rd and 66th percentiles.
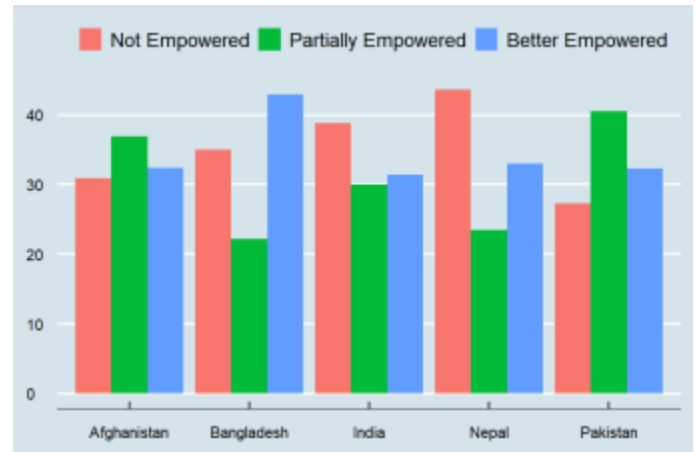
Figure 1: Frequency of Mean Empowerment Index
Source: Author's Calculation

4.3 Empirical Specifications

Since our dependent variable, the Empowerment Index, is ordinal in nature (no empowerment, partial empowerment, better empowerment) we use the ordinal logistic regression to identify the influence of employment characteristics on empowerment. The ordinal logistic regression is considered a generalization of a binary logistic regression model when the response variable has more than two ordinal categories. This model is used to estimate the odds of being at or below a particular level of the response variable, however, with some manipulation, it can be used to estimate the odds of being beyond a particular level of the response variable as well. One of the main assumptions of the ordinal logistic model is the proportional odds assumption which means that the relationship between each pair of outcome groups is the same. We run our regressions assuming that this holds true. We also ran ordinary least squares regression on both continuous mean and sum empowerment index and presented them in the Appendix to check the robustness of the results. The ordinal logistic regression model that estimates the odds of being beyond a particular level can be expressed in the logit form as follows:

= logit coefficients
$logit[\pi(Y > j | x1, x2, ..., xp)] = ln\ \beta ij$
$\pi(Y > j | x1, x2, ...xp)\ \pi(Y \le j | x1, x2,$
$= \alpha j + (\beta 1jX1 + \beta 2jX2 + ... + \beta pjXp)$
where,

αj = intercepts or cut points
Xp = Set of independent variables

4.3.1 Model Specification I

The first model examines the relationship between empowerment and employment status to test the primary assumption that simply being employed leads to empowerment.

4.3.2 Model Specification II

Having tested the assumption that there is a relationship between employment and empowerment, the second model assesses the linkage between the type of occupation working women are engaged in and their empowerment. To examine this relationship, we omitted non-working women from the sample to focus on working women and their occupations.

4.3.3 Model Specification III

Finally, the third model examines whether the woman's employment status (working for a family, someone else, or self-employment) affects her level of empowerment.

Results

5.1 Model Specification I

Table 5 displays the regression results for Model Specification 1, examining the relationship between women's empowerment index and their working status. The findings reveal that working women have a higher likelihood of experiencing better empowerment compared to non-working women. Moreover, women with higher levels of education report better empowerment. It is concerning that urban women tend to report higher empowerment than rural women, especially considering that the majority of women in the countries under study reside in rural areas, as shown in Table 4. Across all countries, except Afghanistan, wealthier women exhibit higher levels of empowerment. In Afghanistan, this may be attributed to the fact that even if women come from affluent families, control over wealth is determined by male family members, thereby restricting their agency. Surprisingly, women whose household head is female demonstrate higher empowerment, despite the coefficient suggesting the opposite and being statistically insignificant in the

case of Afghanistan. This suggests that women's leadership position at home does not significantly influence their empowerment. It is possible that this leadership position is temporary and only occurs following the death of the male head, until the next male assumes the role. From the literature, we gather that in Afghanistan, social group identity outweighs individual identity. Afghan women are integral members of their familial unit and often do not separate their personal needs from the needs of their families. Although women have access to various opportunities, not all of them can exercise their rights to study, work, and make their own choices (Rostami-Povey, 2007). Men may manipulate or misinterpret Islamic ideologies to control and suppress women's lives (Kissane, 2012; Ahmed-Ghosh, 2003). Consistent with previous studies on the association between fertility and women's empowerment, women with children under five tend to report lower levels of empowerment (Upadhyay et al., 2014). Surprisingly, belonging to the major religion of the country negatively affects empowerment, contrary to our assumption that the relationship would be the opposite. The appendix contains the results from the ordinary least squares model, with the dependent variable being the continuous mean empowerment index. We observe that working has a positive influence on empowerment in all countries, except Afghanistan, although the coefficient is not statistically significant. Additionally, we note that the coefficients are very small, ranging from 0.002% for Afghanistan to 0.14% for Afghanistan. This suggests that the impact of working status on women's empowerment is only minimal.

Table 6 presents the predicted probabilities for Model 1 and confirms the regression findings. In all countries, women who are employed have the highest probability of being highly empowered, while non-working women have the highest likelihood of being least empowered. Numerous studies support the result that employment provides women with a greater sense of purpose and fulfilment which is conducive to exercising autonomy. Working women have a life beyond their family which brings feelings of self-accomplishment and self-esteem. Above all, working provides women with financial autonomy. If a woman has to financially depend on others (usually male members) in South Asian countries where the

patriarchal construct is difficult to dismantle, she will have to be a subordinate figure in every aspect of her life.

Table 5: Ordered Logit Model Predicting Mean Empowerment Index by Socio-Demographic and Working Status

Variables	Afghanistan	Bangladesh	India	Nepal	Pakistan
Working Status (Base: Not Working)					
Working	1.08**	1.21***	1.85***	1.46***	2.33***
	(0.04)	(0.04)	(0.03)	(0.065)	(0.11)
Education (Base: No Education)					
Primary	1.71***	1.28***	1.32***	1.45***	2.13***
	(0.09)	(0.057)	(0.03)	(0.088)	(0.115)
Secondary	2.46***	1.72***	1.67***	2.08***	3.13***
	(0.134)	(0.08)	(0.03)	(0.12)	(0.16)
Higher	4.57***	2.55***	2.8***	3.38***	5.46***
	(0.5)	(0.15)	(0.08)	(0.255)	(0.33)
Residence (Base: Rural)					
Urban	1.35***	1.49***	1.13***	1.4***	1.3***
	(0.05)	(0.049)	(0.018)	(0.062)	(0.05)
Age	1.12***	1.27***	1.204***	1.6***	1.2***
	(0.014)	(0.015)	(0.008)	(0.03)	(0.021)
Age squared	0.998***	0.996***	0.997***	0.994***	0.998***
	(0.0002)	(0.0001)	(0.0001)	(0.002)	(0.0002)
Religion (Base: Non Majority)					
Majority		0.95	1.07***	0.963	
		-0.045	-0.016	-0.06	
Wealth (Base: Poor)					
Middle	0.78***	1.004	1.14***	1.23***	1.25***
	(0.028)	(0.039)	(0.02)	(0.068)	(0.065)
Rich	0.84***	1.12***	1.34***	1.6***	1.4***
	(0.029)	(0.042)	(0.024)	(0.08)	(0.073)
Sex of the Household Head (Base: Male)					
Female	0.85	1.46***	1.12***	3.02***	1.65***
	(0.14)	(0.065)	(0.022)	(0.13)	(0.096)
Children Under Five (Base: No)					
Yes	0.78***	1.01	0.93***	0.81***	0.76***
	(0.029)	(0.03)	(0.013)	(0.035)	(0.031)
Constant	1.5	4.2	3.58	9.009	3.84
Constant	3.14	5.17	5.41	10.205	5.38
	(0.19)	(0.195)	(0.106)	(0.33)	(0.28)
Observations	20,400	18,641	86,053	9,823	12,401

*** p<0.01, ** p<0.05, * p<0.1
Numbers in the parenthesis are standard errors of coefficients. Source: Authors' Calculations.

Variables		Empowerment	Afghanistan	Bangladesh	India	Nepal
Not Working		Low	0.3***(0.003)	0.36***(0.004)	0.36***(0.002)	0.48***(0.008)
		Partial	0.39***(0.0003)	0.24***(0.00032)	0.42***(0.002)	0.27***(0.005)
		High	0.31***(0.0003)	0.4***(0.005)	0.22***(0.002)	0.24***(0.007)
Working		Low	0.28***(0.007)	0.32***(0.004)	0.24***(0.002)	0.39***(0.006)
		Partial	0.39***(0.004)	0.23***(0.003)	0.42***(0.002.)	0.28***(0.005)
		High	0.33***(0.007)	0.45***(0.005)	0.34***(0.002)	0.32***(0.006)

*** p<0.01, ** p<0.05, * p<0.1
Numbers in the parenthesis are standard errors of coefficients. Source: Authors' Calculations.

5.2 Model Specification II

Model Specification 2 delves deeper into the relationship between employment and empowerment, specifically examining the association between occupation and women's empowerment index. Table 7 presents the results, indicating that occupation is indeed associated with women's empowerment. The odds ratios suggest that women in professional occupations have a higher likelihood of experiencing better empowerment in Bangladesh, India, Nepal, and Pakistan. In Afghanistan, women in sales occupations have a greater likelihood of better empowerment. However, it is worth noting that only about 1% of women in Afghanistan are employed in this sector, indicating a very low number of empowered women in Afghanistan overall. On the other hand, women engaged in agriculture, manual

labour, and domestic work tend to have a lower likelihood of empowerment compared to women in professional occupations across all countries. As shown in Table 2, the majority of women in our sample are involved in agriculture, which implies that there are more women reporting low empowerment than those reporting high empowerment.

Highly educated women demonstrate a higher likelihood of being empowered. Additionally, urban women are more likely to experience better empowerment than rural women, which is concerning considering that the majority of women in the studied countries reside in rural areas. The likelihood of empowerment is higher for older women, although the results suggest that this effect diminishes over time. The respondent's religious affiliation is a significant determinant of empowerment only in India. Women following minority religions in India face caste discrimination, economic deprivation, and gender bias, making them some of the most oppressed women in the world (Biswas, 2020). Furthermore, the National Family Health Survey (NFHS) reports that women from lower castes in India have a shorter life expectancy due to limited access to healthcare compared to women from upper castes (Masoodi, 2018).

Wealthier women have a higher likelihood of experiencing better empowerment in all countries except Afghanistan. Women whose household head is female also demonstrate a higher likelihood of empowerment, despite the coefficient suggesting the opposite and being statistically insignificant in the case of Afghanistan. The presence of children under five years old decreases the likelihood of empowerment in all countries and is an insignificant determinant of empowerment in Bangladesh and Nepal.

Table 7: Ordered Logit Model Predicting Mean Empowerment Index by Socio-Demographic and Occupation

Variables	Afghanistan	Bangladesh	India	Nepal	Pakistan
Occupation (Base: Professional)					
Sales	2.174**	0.38***	0.65***	0.9	0.59**
	(0.76)	(0.06)	(0.04)	(0.11)	(0.12)
Agriculture	0.313***	0.36***	0.41***	0.4***	0.39***
	(0.03)	(0.05)	(0.03)	(0.05)	(0.09)
Manual	0.830*	0.46***	0.77***	0.664***	0.59**
	(0.08)	(0.07)	(0.05)	(0.09)	(0.11)
Domestic		0.48***			
		(0.09)			
Education (Base: No Education)					
Primary	2.061***	1.23***	1.33***	1.349***	1.74***
	(0.34)	(0.07)	(0.05)	(0.1)	(0.24)
Secondary	3.051***	1.53***	1.45***	1.75***	1.52***
	(0.44)	(0.1)	(0.05)	(0.13)	(0.23)
Higher	8.180***	1.82***	2.2***	2.23***	3.26***
	(1.78)	(0.18)	(0.14)	(0.23)	(0.67)
Residence (Base: Rural)					
Urban	2.339***	1.26***	1.10***	1.31***	1.55***
	(0.28)	(0.06)	(0.02)	(0.06)	(0.19)
Age	1.072*	1.22***	1.23***	1.5***	1.14***
	(0.04)	(0.02)	(0.02)	(0.04)	(0.05)
Age squared	1	0.997***	0.997**	0.994***	0.998**
	(0.001)	(0.003)	(0.0002)	(0.003)	(0.0006)
Religion (Base: Non Majority)					
Majority		0.88*	1.09***	0.94	
		(0.06)	(0.03)	(0.07)	
Wealth (Base: Poor)					
Middle	0.616***	1.06	1.05	1.117*	1.23
	(0.06)	(0.06)	(0.03)	(0.07)	(0.17)
Rich	0.620***	1.2***	1.18***	1.251***	1.9***
	(0.062)	(0.06)	(0.04)	(0.08)	(0.3)
Sex of the Household Head (Base: Male)					
Female	0.89	1.43***	1.12***	3.21***	1.44***
	(0.326)	(0.1)	(0.04)	(0.17)	(0.23)
Children Under Five (Base:No)					

Yes	0.594***	1	0.86***	0.83	0.73***
	(0.062)	(0.04)	(0.02)	(0.04)	(0.07)
Constant	0.2	2	3.06	1.43	1.1
	(0.55)	(0.34)	(0.22)	(0.74)	(0.74)
Constant	1.9	3.02	4.75	2.89	3.24
	(0.55)	(0.34)	(0.22)	(0.74)	(0.74)
Observations	3,011	9,311.00	25,174	6,884	2,001

*** p<0.01, ** p<0.05, * p<0.1
Numbers in the parenthesis are standard errors of coefficients. Source: Authors' Calculations.

Table 8 presents the predicted probabilities for women's decision-making power and confirms the findings from the regression analysis. In Afghanistan, the occupation with the highest probability of women being highly empowered is Clerical/Sales/Services, while Agriculture has the highest probability of women being least empowered. In the other countries, the occupation with the highest probability of women being highly empowered is Professional/Technical/Managerial, while Agriculture has the highest probability of women being least empowered. Overall, women employed in formal sectors tend to have higher levels of empowerment compared to women engaged in informal sectors.

In South Asia, women are often excluded from asset inheritance or ownership. If they do own land, they typically have limited control over it. As a result, women farmers often work under someone else who may exploit them by paying below-standard wages or not paying them at all if they are family members. Furthermore, agricultural employment is often seasonal, which means women lack the assurance of steady income or job security.

However, it is important to note that relative empowerment does not necessarily imply absolute empowerment. Women in formal employment still face various forms of inequality in the workplace, such as unequal pay. They may also experience career setbacks due to their responsibilities as caregivers for their children (Murthy, 2020). Additionally, women in formal employment are disproportionately affected by gender-based violence, including sexual assault, in the workplace (Gender-based Violence at Work, 2019).

Table 8: Predicted Probabilities of Mean Empowerment Index by Women's Occupation for Model Specification 2

Occupation	Empowerment	Afghanistan	Bangladesh	India	Nepal	Pakistan
Professional/ Technical/M anagerial	Low	0.19*** (0.008)	0.155*** (0.017)	0.155*** (0.007)	0.28*** (0.02)	0.10*** (0.02)
	Partial	0.36*** (0.006)	0.18*** (0.013)	0.33*** (0.007)	0.29*** (0.006)	0.39*** (0.03)
	High	0.45*** (0.013)	0.66*** (0.03)	0.51*** (0.01)	0.43*** (0.03)	0.51*** (0.04)
Clerical/Sale s and Services	Low	0.08*** (0.02)	0.32*** (0.014)	0.22*** (0.005)	0.28*** (0.01)	0.16*** (0.02)
	Partial	0.23*** (0.04)	0.24*** (0.004)	0.38*** (0.003)	0.29*** (0.005)	0.46*** (0.02)
	High	0.69*** (0.07)	0.43*** (0.015)	0.40*** (0.007)	0.43*** (0.02)	0.38*** (0.03)
Agriculture	Low	0.47*** (0.02)	0.33*** (0.006)	0.31*** (0.003)	0.44*** (0.007)	0.22*** (0.02)
	Partial	0.35*** (0.007)	0.25*** (0.005)	0.39*** (0.003)	0.28*** (0.005)	0.49*** (0.01)
	High	0.18*** (0.009)	0.42*** (0.007)	0.3*** (0.003) (0.03)	0.28*** (0.006)	0.29*** (0.03)
Manual	Low	0.24*** (0.01)	0.28*** (0.01)	0.19*** (0.004)	0.33*** (0.02)	0.16*** (0.01)
	Partial	0.38*** (0.004)	0.24*** (0.005)	0.36*** (0.003)	0.29*** (0.005)	0.46*** (0.01)
	High	0.38*** (0.02)	0.48*** (0.01)	0.44*** (0.006)	0.38*** (0.02)	0.38*** (0.02)

*** p<0.01, ** p<0.05, * p<0.1
Numbers in parenthesis are standard errors of coefficients. Source: Authors' Calculations.

5.3 Model III

Model Specification 3 examines the relationship between the type of women's employer and their empowerment. Table 9 presents the results, indicating that women who work for someone outside their family or are self-employed generally experience higher levels of empowerment compared to women working for family members. This suggests that working for family members inhibits women's autonomy. In a patriarchal setting, women may be subjected to various rules and expected to be subservient to their family members. However, once women step outside the domestic sphere and work for someone other than family members, they may have a higher likelihood of exercising autonomy, at least to some extent. The odds ratios for self-employment are significant only for Nepal. However, it is worth noting that in our sample, except for Pakistan, more than 50% of women work for their family members. This suggests that the majority of women report low levels of empowerment while

working for family members.

Table 9: Ordered Logit Model Predicting Mean Empowerment Index by Socio-Demographic And Employer

Variables	Afghanistan	Bangladesh	India	Nepal	Pakistan
Works For (Base: Family)					
Someone Else	1.76***	1.38***	0.98	1.96***	1.34***
	(0.16)	(0.08)	(0.04)	(0.13)	(0.15)
Self-Employed	1.13	1.08*	0.96	1.96***	1.16
	(0.12)	(0.06)	(0.35)	(0.13)	(0.14)
Education (Base: No Education)					
Primary	2.49***	1.25***	1.335***	1.4***	1.83***
	(0.41)	(0.07)	(0.05)	(0.10)	(0.26)
Secondary	3.80***	1.60***	1.60***	1.90***	1.78***
	(0.54)	(0.10)	(0.05)	(0.14)	(0.26)
Higher	9.7***	2.38***	3.17***	2.76***	5.14***
	(2.06)	(0.20)	(0.17)	(0.25)	(0.78)
Residence (Base: Rural)					
Urban	2.77***	1.25***	1.32***	1.31***	1.52***
	(0.33)	(0.06)	(0.04)	(0.07)	(0.16)
Age	1.098***	1.23***	1.28***	1.51***	1.13***
	(0.04)	(0.02)	(0.04)	(0.04)	(0.05)
Age squared	1.00	1***	1***	1***	1**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.001)
Religion (Base: Non Majority)					
Majority		0.9*	1.053*	0.95	
		(0.06)	(0.03)	(0.08)	
Wealth (Base: Poor)					
Middle	0.7***	1.06	1.064425**	1.13*	1.31**
	(0.06)	(0.06)	(0.03)	(0.07)	(0.18)
Rich	0.73***	1.22***	1.27***	1.43***	2.04***
	(0.07)	(0.07)	(0.04)	(0.07)	(0.30)
Sex of the Household Head (Base: Male)					
Female	0.67	1.42***	1.13***	3.07***	1.34**
	(0.24)	(0.10)	(0.04)	(0.16)	(0.21)
Children Under Five (Base:No)					
Yes	0.54	1.01	0.86	0.814***	0.72***
	(0.06)	(0.04)	(0.02)	(0.04)	(0.07)
Constant	1.23	3.28	3.99	8.10	1.91
	(0.53)	(0.31)	(0.21)	(0.39)	(0.72)
Constant	2.84	4.28	5.62	9.41	4.06
	(0.53)	(0.31)	(0.21)	(0.39)	(0.72)
Observations	3,003	9,303	26,637	6,884	2,008

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Numbers in the parenthesis are standard errors of coefficients. Source: Authors' Calculations.

Although the odds ratios for both variables for all countries are greater than 1, since they are significant they do not determine women empowerment. In India's case odds ratios for both working for someone else or self-employment are insignificant which indicates that working for family members is essentially the same as working for someone else or themselves. Women with higher levels of education, who reside in urban settings, are older, have a higher likelihood of empowerment. As observed in Model 2, women who live with a female household head and have greater levels of wealth has a higher likelihood of being empowered in all countries except Afghanistan. The presence of children under five lowers the likelihood of empowerment in all countries except Bangladesh in this model.

Table 10 presents the predicted probabilities for women's decision-making power and aligns with the regression findings. Across all countries, women have the highest probability of being highly empowered when working for non-family members, followed by self-employment. The second-ranking position of self-employment may be attributed to the challenges faced by women entrepreneurs. They often face underestimation of their capabilities and encounter difficulties in obtaining loans and

necessary resources from financial institutions. Moreover, women entrepreneurs have limited networking opportunities compared to their male counterparts, which can hinder their business growth (Roomi Parrott, 2008; Bushell, 2008).

In addition to their business responsibilities, women are also expected to fulfil traditional caregiving roles at home. Working for someone other than family members may provide women with sufficient boundaries from their family members, enabling them to exercise their autonomy and potentially circumvent the challenges faced by women entrepreneurs.

Table 10: Predicted Probabilities of Empowerment by Women's Employer for Model Specification 3

Employer	Empowerment	Afghanistan	Bangladesh	India	Nepal
	Low	0.29***	0.34***	0.25***	0.42***
		(0.01)	(0.006)	(0.003)	(0.007)
For Family member	Partial	0.38***	0.25***	0.38***	0.31***
		(0.01)	(0.004)	(0.003)	(0.006)
	High	0.33***	0.42***	0.36***	0.27***
		(0.01)	(0.006)	(0.003)	(0.006)
	Low	0.18***	0.27***	0.26***	0.27***
		(0.01)	(0.009)	(0.006)	(0.01)
For someone else	Partial	0.35***	0.23***	0.38***	0.31***
		(0.01)	(0.004)	(0.003)	(0.006)
	High	0.47***	0.5***	0.36***	0.42***
		(0.02)	(0.01)	(0.008)	(0.01)
	Low	0.26***	0.32***	0.27***	0.27***
		(0.02)	(0.009)	(0.006)	(0.01)
Self-employed	Partial	0.38***	0.24***	0.38***	0.31***
		(0.01)	(0.004)	(0.003)	(0.007)
	High	0.36***	0.44***	0.35***	0.42***
		(0.02)	(0.01)	(0.007)	(0.02)

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Numbers in the parenthesis are standard errors of coefficients. Source: Authors' Calculations.

Conclusion and Policy Suggestions

In this paper, we have explored the relationship between women's employment and women's empowerment in Afghanistan, Bangladesh, India, Nepal, and Pakistan. To measure empowerment, we constructed an empowerment index based on various indicators, including decision-making power in household matters, healthcare, sexual autonomy, freedom of movement, control over earnings, and access to a bank account. Through ordinal logistic regression and ordinary least squares regressions, we ensured the robustness of our results.

We can draw some broad conclusions regarding the role of employment in women's empowerment. Results suggest that women's working status, occupation and employer are significant determinants of women's empowerment across countries. Occupation and the type of employer being significant determinants of empowerment is especially salient because it tells that simply working does not empower women. We found that women employed in the formal sectors are more likely to be better empowered than women employed in informal sectors. Women employed in professional/technical/managerial positions are the best empowered in Bangladesh, India, Nepal, and Pakistan and women employed in service sectors are most empowered in Afghanistan. Women employed in agriculture were the worst empowered across all countries. Since the majority of the women in our sample are employed in the agricultural sector this is something policymakers should consider while planning empowerment schemes. Most of the effort has to be directed to empower women who are employed in the informal sectors. Although the result has indicated that women in formal sectors are more empowered, there is no reason to believe that women in these sectors do not go through abuse at the workplace or have to be subject to discrimination at home. We observed that women who are working with someone outside their family members are the most empowered followed by women who are self-employed across all countries. Women who are working with family members might not have the latitude to exercise decision-making or control over their earnings.

A significant observation is that women working for someone outside their family members demonstrate

the highest empowerment, followed by self-employed women across all countries. This suggests that women employed by family members may face limitations in decision-making and control over their earnings. The case of Afghanistan stands out, as both having a female household head and higher levels of wealth negatively impact women's empowerment. This can be attributed to male control over women's asset ownership and leadership positions within the household. Hence, wealth ownership and household leadership should not be equated with empowerment without considering the underlying dynamics. Factors such as higher levels of education, urban residence, and age consistently emerge as important determinants of women's empowerment across all studied countries. In India, practising the dominant religion positively and significantly impacts the empowerment index, reflecting the strong influence of religious sentiments. Dalit women, considered "lower caste," face multiple forms of oppression, including gender bias, economic deprivation, and caste discrimination. Religion, however, does not play a significant role in determining empowerment in other countries. Furthermore, the presence of at least one child under the age of five contributes positively to empowerment in Bangladesh only.

Our findings indicate that different determinants have varying significance in different countries, influencing women's empowerment positively. Common policies to enhance women's empowerment across all countries should focus on girls' education, ensuring their enrollment and progression to higher levels. Education equips women with qualifications for better employment, delays marriage, and enhances awareness of their rights. Women in the informal sector bear the burden of unpaid work and domestic caregiving. Macro-level policies targeting social infrastructure, such as childcare services, can alleviate women's domestic workload. Monetary policies facilitating credit access for women entrepreneurs and women farmers can help them build financial independence without relying on others. The case of Afghanistan highlights the need for regulatory changes to prevent others from controlling land owned by women. Although changing outcomes influenced by religious sentiments is challenging, governments and welfare organizations can offer scholarships, credit facilities, and subsidized healthcare to women from minority communities, as observed in India. Given that rural women report lower levels of empowerment than their urban counterparts, special protections should be provided to rural women against exploitative labour practices and other forms of exploitation. Encouraging the transition of women from informal to formal sectors of employment is a crucial step toward empowering women in rural economies.

Most importantly, dialogue on women's empowerment has to begin within households and communities. As we have observed, empowerment encompasses broad definitions, and having autonomy in one aspect of life does not automatically translate to overall empowerment for women. Merely being employed does not guarantee protection against gender-based discrimination. Considering our previous mention that it will take South Asia 197 years to close the gender gap, the region needs to make relentless efforts to empower women in the identified areas where they are most vulnerable.

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Road to Circular Economy in Construction Industry

Sahil Shenai

Abstract

Climate Change is rightly becoming our foremost concern. Average Global Temperature is rising, our natural resources are depleting, and the question of disposal has become as big as ever. The Construction Industry, which is explosively growing, is one of the biggest scourges for the environment. Statistics related to its environmental damage are both alarming as well as aspiring. Circular Economy exhilaratingly proposes promising solutions to the aforementioned problems. In a circular economy, waste materials from other industries will be used as raw materials for the construction industry. While the construction and demolition waste will be used as raw materials for other industries. In theory, it promises to reduce CO2 emissions, extraction of mineral resources used for construction, and solid waste dumped into landfills. In this article, we build a theoretical business model in the Construction Industry in Circular Economy, check its feasibility and challenges to implement it.

Methodology:

1. We entered keywords related to the topic on the database of research papers, Springer; and reviewed all the relevant research papers. Our bibliography includes research from material scientists, economists, and environmentalists. The CEO of a construction company, a Civil Engineer, and a Senior Manager in another construction company were interviewed in February 2023.
2. We take real data of a building constructed in Pune; and look at what changes in cost will occur with our proposed changes.

Contribution:

This study reviews the literature, applies the latest research discoveries on business; and builds a model based on that.

Introduction

Rubble is the most exhaustive and seemingly non-segregable kind of waste. All the things which make a livelihood, from toothpaste to television, are crushed inside.

It is astonishing how largely it contributes to landfills. 30% of the total waste going into landfills is from Construction and Demolition Industry (Maria et al., 2018).

It is 200% of the Municipal Waste. India produces 150 million tons of Demolition Waste every year and 99% of it goes into landfills unprocessed (Ghosh; 2022).

Construction Industry produces a lot of GreenHouse Gases, consumes a lot of energy in the manufacturing process and leaves mountainous rubble after it is demolished. What's more scary is the rate at which it is growing. 94 million people are going to migrate to urban India in the next 7 years. Most of the buildings that will exist in 2040 are not even built yet (RBI Report; 2022). This industry is a disaster for the environment. However, what is exhilarating to know is that the construction industry, as surprising as it is, fits perfectly into a model Circular Economy.

Currently most of the industries are in the Linear Economy. It follows a linear chain of extraction of raw materials – manufacturing – consumption – and disposal, called Cradle-to-Grave approach. But Circular Economy instead takes the Cradle-to-Cradle approach. Waste Products, instead of disposing them off, are utilized as raw materials for other industries. And waste products of those industries are utilized as raw materials for some other industries. We minimize waste by keeping the resources revolving from industry to industry; and maximising their utility.

Talking of Construction Industry, most of the raw materials which go into the making of a building can be waste products from other industries. And demolition waste; can very well be recycled and reused as raw materials for other industries. In this research article, we are going to see how this scourge for the environment can actually become an environment-friendly industry.

Waste Products as Raw Materials of Construction Industry:

Cement:

Our journey starts with Cement production. Because that is the main culprit. 6% of all man-made CO_2 emissions happen during the production of cement alone (Sahoo; 2020) Ways to reduce CO_2 are reverse calcination; or reuse it in other industries. Or another way is by reducing cement itself.

Conc. Grade [MPa]	Conc. Name	Total Powder [kg/m³]	Slag [%]	k_{28}	Aggregate, [kg/m³]				[w/(c + k_{28} * g)]	HRWR [%]	VMA [%]
					20 mm	12 mm	6 mm	Sand			
20	SCC20	550	90	0.69	268	373	224	766	0.78	0.3	0.25
30	SCC30	550	80	0.70	271	376	227	774	0.59	0.5	0.30
60	SCC60	550	60	0.77	274	380	229	782	0.36	1.0	0.20
90	SCC90	550	40	0.92	282	392	236	806	0.27	1.5	0.20
100	SCC100	550	30	1.02	288	400	241	823	0.25	2.2	0.05

Table 1

Research has shown (Table 1) that we can replace almost 90% of the cement with a waste product of the iron industry called GGBF slag. By replacing 30% to 90% of the cement in concrete, we can achieve compressive strengths from 20 Megapascals to 100 Megapascals (Sethy et al, 2020). To put it into perspective, you can build Worli Sea Link which is braving waves and winds by replacing 60% of cement, and build a 65-story building by replacing 40% of the cement. Most of the buildings use concrete of 35 Megapascals, which could be built by replacing 80% of the cement.

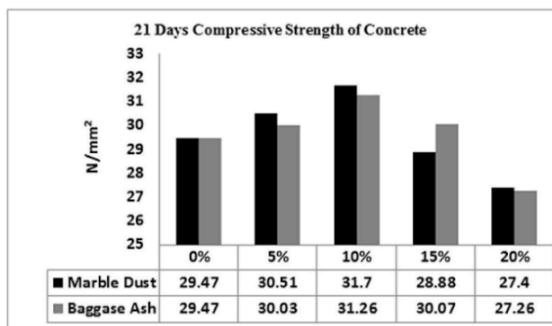The concrete made from this mixture passes all the workability tests like Slump Flow Test, V funnel test, and L- tube test.

Other three alternatives for cement apart from Iron Slag, are marble dust, bagasse ash, (Vairagade et al, 2016) and Geopolymer. However, marble dust can only replace 10% of cement that too with non-sufficient compressive strength (see Table 2). While Geopolymer could be a promising substitute, it comes at a three times higher price than cement, and also with collateral environmental damage.

By replacing cement with GGBF slag, we are reducing the amount of cement produced, giving our concrete more strength and durability, and also, using the slag which would otherwise have gone into landfills and occupied space.

Concrete:

Concrete is made up of three ingredients: Cement, Fine aggregates, and coarse aggregates.

For fine aggregates and coarse aggregates respectively, we are currently using sand and gravel. Both of them are non-renewable mineral resources which are freshly extracted. What the circular economy proposes instead, is to replace Fly Ash for sand, and Demolition Waste for gravel. Fly Ash is anyways a waste product of coal plants and

Details of the Mix Proportion (kg/m³)

Mix	Cement	Water	Sand	Fly Ash	Aggregates
MF0	450	180	450	Nil	900
MF10	450	180	405	45	900
MF20	450	180	360	90	900
MF25	450	180	337.5	112.5	900
MF30	450	180	315	135	900
MF35	450	180	292.5	157.5	900
MF40	450	180	270	180	900

Table 3: Details of Mixture Proportion where we are replacing Sand by Fly Ash

21 Days Compressive Strength of Concrete	0%	5%	10%	15%	20%
Marble Dust	29.47	30.51	31.7	28.88	27.4
Baggase Ash	29.47	30.03	31.26	30.07	27.26

Table 2: Compressive Strength of Concrete vs Percentage of Cement Replaced by Marble Dust and Bagasse Ash
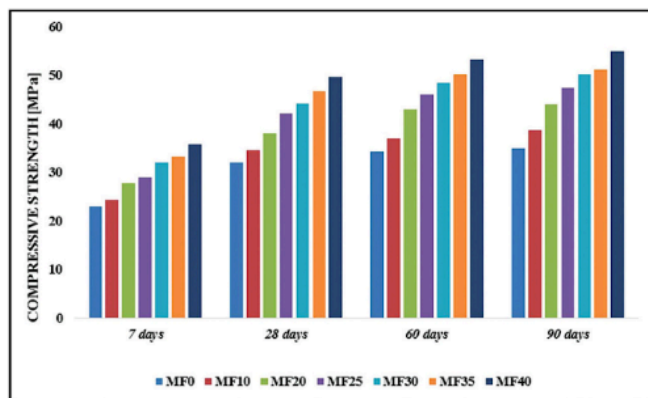

Table 4: Compressive Strengths of Mixture Proportions made in Table 3

demolition waste here means small pieces of concrete which come out of demolition.

Research has shown that 50% of the sand and 100% of the gravel can be replaced without compromise in, and in fact, increment in strength, durability, and other properties (Sikder et al, 2019).

Figure 1: Clay Bricks   Figure 2: Papercrete Bricks

Last but not least, clay bricks could be replaced by Papercrete bricks. Papercrete bricks are made up of paper which is not capable of further recycling. These bricks can be used for making non-load-bearing interior walls.

Resources used during Construction:

One resource which is used heavily during construction is water. Construction industry uses up to 12% of the freshwater that is available. But this water can be harvested and reused. According to our interviewee, builders are not currently harvesting this water. A little innovation and initiative from the side of builders will rectify this.

Demolition Phase:

Currently, buildings demolished beyond 30 years of age are given maximum benefits by the Maharashtra Government. And banks are not giving loans to buy a flat in a building beyond 50 years of age. So, 30 to 50 years becomes an ideal bracket for buildings to live inside. Policy changes can enhance the longevity of buildings. We also have buildings more than 500 years of age.

Design to Dissemble:

A new trend is rising to make a building which could easily be dissembled, part-by-part, after its age is over. The Netherlands is already on this. Viaducts and bridges are products used as a service. Bridges are rented for a particular amount of time. And after its age is over, it is dissembled and taken back by the providing company. These companies operate in Public-Private Partnership mode.

Recycling Demolition Waste:

Only 1% of Demolition waste is recycled in India currently (Ghosh et al, 2022). Only three major recycling plants exist. They are in Delhi and Ahmedabad. We propose these plants be built in West Bengal which is the most cyclone-prone area in India. Natural calamities also produce great amounts of construction waste.

Feasibility of this Business Model:
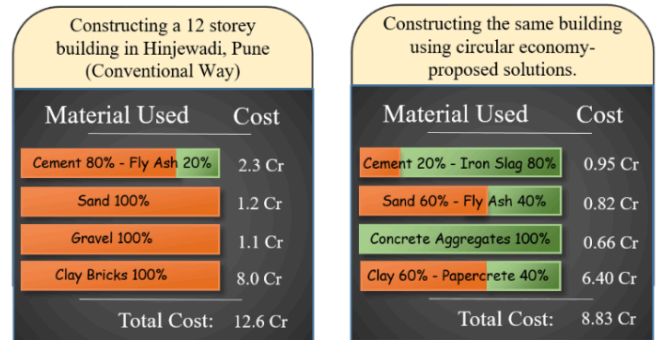

Figure 3   is   Figure 4

The data above (Figure 3) is of a real 12-story building constructed in Pune. Let's substitute (see Figure 4) 80% cement by GGBF slag, 50% sand by Fly Ash, and 100% gravel by demolition waste; and make all interior walls of papercrete bricks. Costs of slag and fly ash are as per the best suitable deals available on IndiaMart. They are inclusive of the cost of logistics. The cost of demolition waste and papercrete bricks is assumed. We see that in total, in making of a 12-story building in Pune, we actually save 4 Cr rupees. An increase in marginal profit will benefit builders as well as consumers.

Challenges for Implementation:

As we saw, constructing buildings according to the circular economic model benefits builders. Then the obvious question is, why aren't they already doing it? The reason is simple. Firstly, the research proposing all these changes is young. Awareness about it is absent. And most importantly, Civil Engineers cannot prescribe concrete mixture designs at their own pleasure. They must strictly adhere to the Indian Standard Codes, and they cannot by themselves, make any changes.

We had filed an RTI with the Government to know if there are any plans to incorporate this research in

Indian Standard Codes. But we haven't received any reply yet.

This research needs vigorous cross-checking, testing, piloting, experimenting, etc. before it becomes our mainstream method of constructing buildings, where human life is at stake.
The best part about this model is that any qualified Civil Engineer can make these changes on-site. It is very easily implementable.

Environmental Impact

Through our methods of circular economy, we would prevent 21 Cr tons of carbon dioxide from being created; save 35 million tons of sand and gravel from being extracted, and save huge amounts of demolition waste, paper, fly ash, and iron slag from being dumped into landfills. Respective Figures are as follows:

Iron Slag	Fly Ash	Demolition Waste	Paper
2.5 Cr Tons	22 Cr Tons	60 Cr Tons	1.2 Cr Tons

Table 5: Amount of Articles Dumped in Landfills every year in India.

Conclusion

Millions of people die due to air pollution every year. People of Phursungi, which is major landfill of Pune (and people at various other places) are facing grave diseases because of poorly managed solid waste, and our non-renewable resources are quickly depleting. Circular Economy proposes a promising solution to all these problems. We present a study in which we construct a prototype building in a circular economy in the construction industry, which creates a lot of problems for the environment but has enormous potential to alleviate its effects in the circular economy.

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Fiscal Policy Support during the Covid-19 Pandemic and its Impact

Atiriya Singh

Abstract

This paper aims to analyze the fiscal policy support implemented during the Covid-19 pandemic in advanced, emerging and low-income economies, by focusing on policy responses enacted in the United States of America, India and low-income countries of Africa. The paper seeks to evaluate the differences in the scale and magnitude of fiscal support, its effectiveness and long-term impact by looking at the level of fiscal stimuli injected, programs adopted, government expenditure undertaken and their respective consequences.

Introduction

Covid-19 is an infectious disease caused by the SARS-CoV-2 virus, which originated in Wuhan, China, at the[1] end of 2019, and soon spread throughout the world, claiming an estimated 6.7 million lives. The World Health Organization declared the outbreak a global pandemic on 11 March 2020. The lockdowns that followed caused huge disruptions in economic activities, trade and a massive fall in output and employment, leading to,[2] allegedly, the largest contraction since the Great Depression, pushing more than 90 per cent of the world into a recession in 2020.

Policymakers rushed to cushion the huge blow with fiscal and monetary policies that were unparalleled in both momentum and magnitude. This paper aims to explore the fiscal policy response and evaluate its impact. While advanced economies supplied massive fiscal policy stimulus, emerging market economies and low-income countries' responses were limited but still sizable, given their historical precedents.

Figure 1a depicts the wide variation in budgetary fiscal support to people and firms across countries, and figures 1b, 1c and 1d show the scale of fiscal policy support in advanced, emerging and low-

income countries, respectively. This paper seeks to establish the degree to which these fiscal policies were successful in lowering the impact of Covid-19.
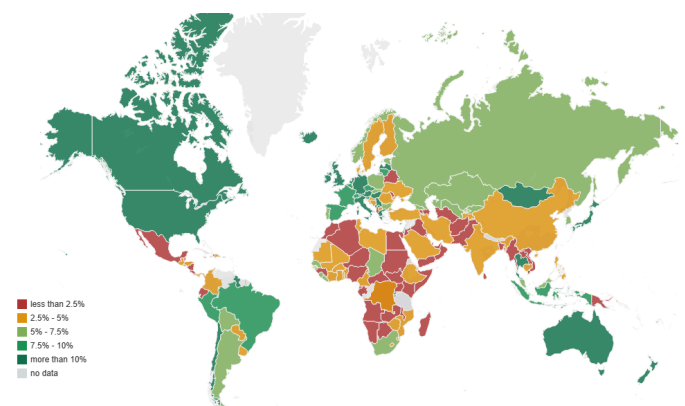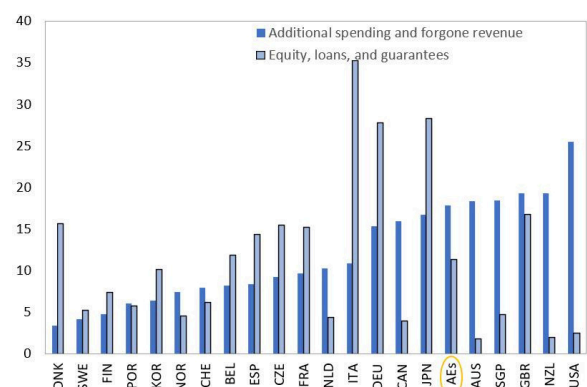

Figure 1a: Additional Spending and Forgone Revenue in Response to the Covid-19 Pandemic (Per cent of 2020 GDP) Source: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19

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[1] *Elflein, J. (2023, January 9). Novel coronavirus (COVID-19) deaths by country worldwide 2023. Statista. Retrieved January 17, 2023, from https://www.statista.com/statistics/1093256/novel-coronavirus-2019ncov-deaths-worldwide-by-country/ .*

[2] *World Economic Forum. (2020, June 18). World Bank: 5 charts to understand the coronavirus recession. The World Economic Forum. Retrieved January 17, 2023, from https://www.weforum.org/agenda/2020/06/coronavirus-covid19-economic-recession-global-compared/*

Figure 1b: Discretionary fiscal policy support during Covid-19 in advanced economies
(Percent of 2020 GDP)
Source: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19

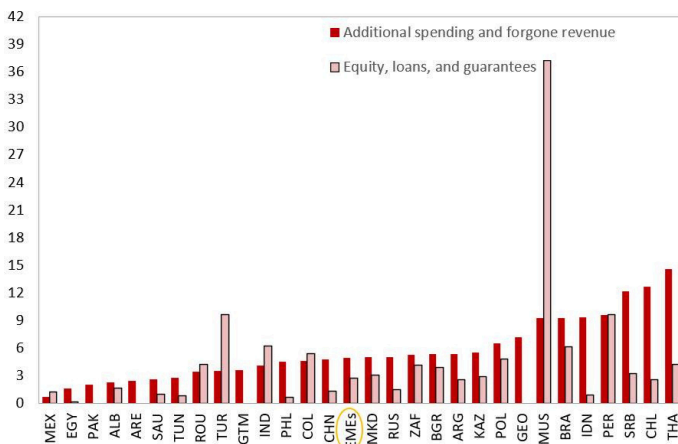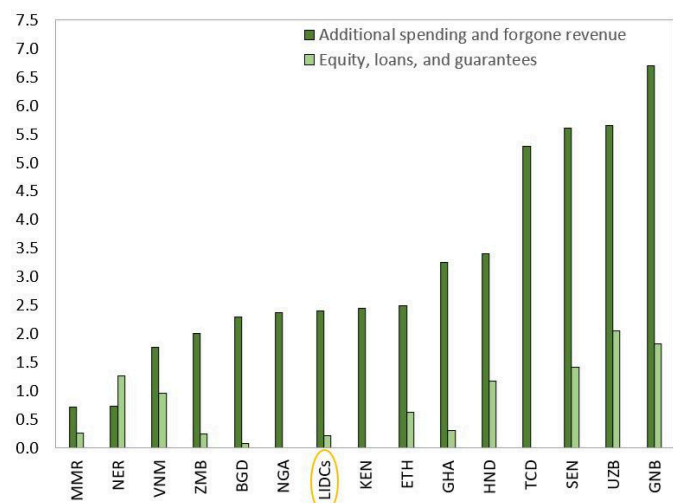**Figure 1c**: Discretionary fiscal policy support during Covid-19 in emerging markets
(Percent of 2020 GDP)
Source: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19

Figure 1d: Discretionary fiscal policy support during Covid-19 in Low income developing countries (Percent of 2020 GDP)
Source: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19

Thus, this paper attempts to analyze the fiscal policy responses of central governments to Covid-19 and its impact by focusing on the United States of America, India and low-income countries of Africa, to see the difference in measures adopted between advanced, emerging and low-income economies.

Literature Review

A number of studies have been published analyzing the impact of fiscal policy support during the Covid-19 pandemic. Roshen Fernando and Warwick J. McKibbin, in their ADBI working paper, examine Asian economies' fiscal policy responses to the crisis in 2020. They adopted an additional 2% of GDP increase in both, transfers to households and government expenditure on goods and services, as well as an increase in government infrastructure expenditure. The fourth policy they list concerns healthcare, requiring testing and quarantining infected people along with rapid vaccination by mid-2021. According to them, the measure most beneficial in facilitating an economic revival is the public health policy. They conclude that fiscal policies aid economic revival, with government infrastructure securing the most short-run stimulus and long-run growth benefits.

A Research and Policy Brief from the World Bank Malaysia Hub explores the human and economic costs of the pandemic, stating that they are likely to be larger for developing countries since their fiscal policy support may not be as successful because their monetary transmission mechanism is feeble and fiscal space and multipliers are generally limited. According to them, safeguarding the continuation of public services and supporting the vulnerable is a more feasible target for developing countries. They establish the importance of international coordination in all spheres to deal with this global crisis.

Olive J. Blanchard, in his paper titled "Designing the Fiscal Response to the COVID-19 Pandemic," states that the rapid measures being taken will most probably result in very large fiscal deficits. He states that in this circumstance, fiscal policy responses must focus on three targets. First, to defy the virus; second, to provide disaster relief and protect people from hunger and firms from bankruptcy; and third, to alter aggregate demand so that it deviates as little from the potential output as possible. According to him, such policies will lead to a large increase in debt, but since interest rates will probably stay low for a while, debt will continue to be viable. Developing economies, on the other hand, will require aid to wade through troubled waters. But, in

contrast to the above-mentioned study, he mentions that coordination of fiscal policies is not necessary.

Soyres et al. examine the probable role of large fiscal spending as a propeller of price rise. They analyze the effect of fiscal policy responses on demand and supply across countries throughout the coronavirus pandemic. They state that fiscal policy support heightened goods' consumption with a negligible effect on production, thus boosting excess demand pressure in the market.

Consequently, fiscal support led to price tensions. They depict that countries enacting massive fiscal policy responses were met with greater inflationary challenges.

Kovač et al. investigate the short and long-run impacts of the fiscal stimulus during the pandemic in the EU-27. They find that in the short run, fiscal stimulus was quite useful and that in the long run, the pandemic would possibly have had a lasting and negative effect on potential GDP growth in the absence of fiscal policy responses.

Focus on India

In India, the first case of Covid-19 introduction was reported on 30 January 2020, and a nationwide lockdown was imposed in March 2020, when the approximate number of cases was 500. The number of cases and deaths rose drastically during the second wave of the pandemic, and the GDP contracted sharply in the second quarter of 2020 (-24.4 per cent year-on-year) due to massive lockdowns. In the initial stages, the government provided financial help to vulnerable and low-income households in the form of cash and in-kind incentives. Soon after, it expanded this relief to numerous other sectors. Growth returned to positive magnitudes in the fourth quarter of 2020 at 0.5%, when the central government issued Unlock 5.0 and stood at 1.6% in the first quarter of 2021.

The Indian government's fiscal policy responses are branched into two categories:

(i) Above-the-line actions, which include government expenditure (about 3.5 per cent of GDP), foregone or shelved revenues (about 0.3 per cent of GDP due in 2020-21) and expedited spending (about 0.3 per cent of GDP due in 2020-21).
(ii) Below-the-line actions outlined to support businesses and secure credit provision for various sectors (about 5.3 per cent of GDP).

In the initial stages, during April 2020, above-the-line actions included in-kind (food; cooking gas) and cash transfers to the poor (1.2 per cent of GDP), wage support and employment provision to low-wage workers (0.5 per cent of GDP) and medical insurance for workers in healthcare and healthcare infrastructure (0.1 per cent of GDP).

The May and November 2020 measures, under the Atma Nirbhar Bharat package included further public investment (increased capital expenditure and interest-free loans to states constituting about 0.2 per cent of GDP) and support schemes for certain sectors, including a Production Linked Incentive scheme focussing on 13 sectors with an estimated cost of 0.8 per cent of GDP over 5 years and an increased fertilizer subsidy (0.3 per cent of GDP). Various tax relief measures were reported. The government also responded with actions that would not have an immediate effect on the government's deficit position. This included the provision of credit support to businesses (1.9 per cent of GDP), poor households (1.6 per cent of GDP) and vulnerable electricity distribution companies (0.4 per cent of GDP), as well as specific aid for agricultural infrastructure development (0.7 per cent of GDP), with some miscellaneous support expenditure (0.3 per cent of GDP).[3]

Key elements of actions taken to support micro, small, and medium-sized enterprises included higher coverage, collateral-free loans and a corpus to fund equity. Further, support for agriculture focussed on concessional credit to farmers, credit provision for street vendors and promotion of the production of high-value primary products. The budget for FY 2021-22 boosted expenditure on healthcare with a

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[3] *International Monetary Fund. (2021, july 2). Policy Responses to COVID19. International Monetary Fund. https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#I*

coronavirus vaccination scheme, amounting to Rs. 350 billion. In April 2021, to mitigate the rise in infections, the distribution of free food grains to 800 million individuals in May and June (cost:260 billion rupees) was announced, and the provision of interest-free loans to states for capital expenditure was extended (150 billion rupees). The deployment of the Disaster Response Fund to state governments was also hastened (from June to May). The government waived customs duties and other taxes on vaccines, oxygen and oxygen-related equipment to expand their supply.

Figure 2(a-d): Altering composition of fiscal policy measures in India in 2020-21 and 2021-22
Source:https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap02.pdf

Figure 2e: Composition of fiscal policy measures in India (June-December 2021)
Source:https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap02.pdf

Figure 2 summarizes the mix of the central government's fiscal policy responses to Covid-19 through 2020-21 and 2021-22.

Labour reforms and regulations in the energy sector were announced to encourage investment in the manufacturing sector. Thus, the goal of the fiscal policy response was to enable recovery mainly through the investment channel and consequently, capital expenditure attained double-digit growth during April–November 2020-21.

Figure 3: Quarterly capital expenditure trends
Source: CGA Monthly Accounts
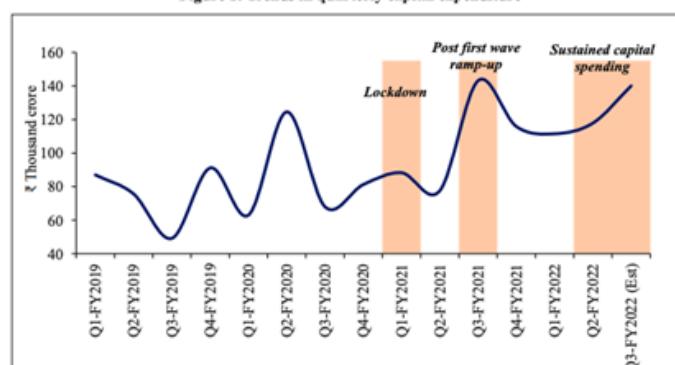
Continued focus on capital expenditure is indicated by Figure 3, wherein capital expenditure followed an increasing path in the first three quarters of 2021-22.

Only a few provisions led to additional expenditures, with most of them being financed by reallocation of funds. The Reserve Bank of India expected that spending on investment, instead of consumption, would lead to higher growth during the medium run. They stated that when economic recovery takes place in the future, balancing the fiscal-monetary trade-off will probably be essential.

The Covid-19 crisis did result in an increase in the fiscal deficit, however, the Reserve Bank of India mentioned that prioritizing capital expenditure will lead to an economic revival, and consequently, the

fiscal deficit will fall and stay viable.[4]

Focus on Low-Income Countries of Africa

Like the rest of the world, low-income countries (LICs) of Africa responded to the pandemic with lockdowns and significant restrictions on economic activity. Although the magnitude and capacity of their policies fall flat in front of advanced economies, the aggregate pandemic budget of African countries was estimated at $37.8 billion in April 2020, and 84% of that amount was shared by Egypt and South Africa.[5] The US, on the other hand, accounted for an expenditure of $6 trillion in Covid 19 response actions, and the European Union introduced a $500 billion stimulus package. The majority of the LICs had inadequate financial ability to mitigate the pandemic. Furthermore, avenues for ensuring external financial aid were constrained since every country was battling a similar crisis.

Analogous to India's response, African nations initially targeted support measures for vulnerable populations. Increased comprehension of the pandemic dynamics enabled more African countries to focus on reopening their economies and aim their macroeconomic policies at an economic revival.

Fiscal policy primarily focuses on taxation, subsidy, public expenditure and deficit-financing instruments, and a majority of the LICs in Africa used one or more of these policies. Budget assistance for the healthcare sector was the most dominant fiscal stimulus, achieved with the help of an expansionary fiscal policy or a shift in priorities. Very few LICs enacted social transfer programmes for households or firms, and the fiscal policy response was limited in terms of size, lying between 1% to 2% of the gross domestic product. Senegal, Niger, Mozambique and Namibia were the few outliers with fiscal policy responses lying above 4% of GDP.

Inadequate digital and financial support for the people hampered the distribution of relief measures, and the non-existence of a social register limited the efficacy of a fiscal response. In the face of these barriers, LICs still came up with various out-of-the-box and cost-reducing measures, such as a utility bill freeze and a waiver of fees for essential services in Niger, distribution of foodgrains in Senegal and Liberia and tax relief in Senegal and Madagascar.

An expectation of a fall in revenue of more than 12% in 2020 indicates the impact of Covid-19 on the majority of the African economies. Therefore, domestic assets made only a meagre contribution to government policy measures. However, it is noteworthy that prompt debt relief and donor-provided credit facilities enabled an increase in fiscal space in many African LICs.

An economic stimulus index was formulated by Elgin, Basbug and Yalaman to evaluate monetary, fiscal and exchange rate measures across countries.[6] A research paper by the South African Institute of International Affairs used this index to examine the response of LICs in Africa during the Covid-19 crisis.[7] The study stated that, with the exception of Senegal, economic policy impact has been feeble across LICs in the continent and they registered a negative score, as depicted in Figure 4a. Actual growth rates in the first and second quarters of 2020 in the LICs were worse than the rates the IMF forecasted (Figure 4b).
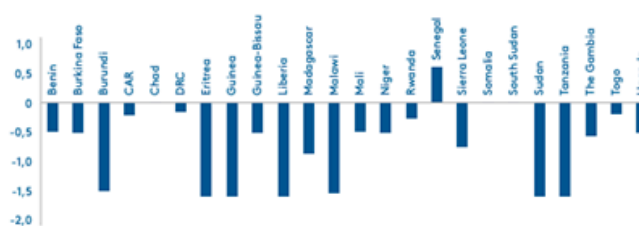
[4] Reserve Bank of India. (n.d.). Monetary and fiscal policy interactions in the wake of the pandemic. Bank for International Settlements. Retrieved January 17, 2023, from https://www.bis.org/publ/bppdf/bispap122_j.pdf

[5] Adeniran, Adedeji. Comparative Study of Policy Responses to COVID-19 in LICs in Africa. South African Institute of International Affairs, 2020. Retrieved January 17, 2023, from http://www.jstor.org/stable/resrep28263

[6] Ceyhun Elgin, Gokce Basbug and Abdullah Yalaman, Economic Policy Responses to a Pandemic: Developing the COVID-19 Economic Stimulus Index, Covid Economics 1, no. 3 (2020): 40–53.

[7] Adeniran, Adedeji. Comparative Study of Policy Responses to COVID-19 in LICs in Africa. South African Institute of International Affairs, 2020. Retrieved January 17, 2023, from http://www.jstor.org/stable/resrep28263

Figure 4b: Growth rate of GDP

The positive correlation of the stimulus index with the number of Covid-19 cases, as visible in Figure 4d, and the negative but faint relationship with the number of deaths (figure 4c) indicates that economic policy impact in LICs is largely dependent on the prevalence of Covid-19, not the death rate.
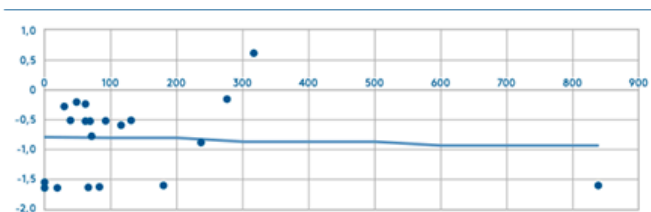

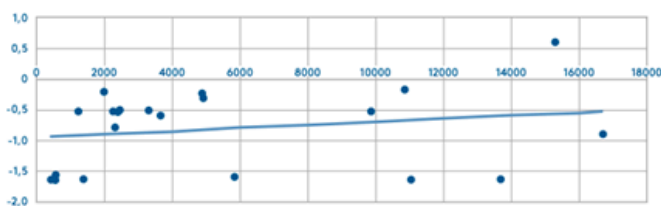Figure 4c: Covid-19 deaths vs. Stimulus index

Figure 4d: Covid-19 cases vs. Stimulus index
Source: "Comparative Study of Policy Responses to COVID-19 in LICs in Africa." South African Institute of International Affairs, 2020.

The study further stated that countries with high debt levels or high inflation before the pandemic had lower scores on the index, while those with high revenue levels had higher scores. This confirms the belief that restricted fiscal space and ailing macroeconomic conditions are barriers to the successful impact of economic policies in LICs in Africa. Thus, the deficient economic response in LICs in Africa is a consequence of previous economic issues. This result is confirmed by the existing literature on the significance of past circumstances for economic development.

Focus on the United States of America

The US reported its first case of Covid-19 in January 2020. Since then, cycles of outbreaks, containments, reopening and a consequent rise in infections have followed. With rapid Covid-19 vaccinations, incidence of new cases decreased. In the second quarter of 2020, the U.S. economy contracted by 31.4 per cent but has recovered strongly since then.[8]

The US is said to have had one of the most aggressive fiscal policy responses to the pandemic. In the first year of the crisis itself, the US government announced three waves of unrivaled fiscal policy stimulus, accounting for nearly 25% of 2020 GDP (over $5 trillion).[9]

Looking at the size of early fiscal packages in the OECD countries (as of 2000), taking into account only the actual budgetary effect of measures, the US fiscal policy response is clearly remarkable, as shown in Figure 5. It spent around 50 per cent more than the United Kingdom, and approximately three times the amount spent by Spain, Italy or France. New Zealand spent as much as the US in relation to the size of its economy.

The $2.4 trillion Wave 1(March-April 2020) of the US government's fiscal policy response was composed of four bills. This quick measure enabled households, firms, and governments to chalk out their way through the crisis. The Coronavirus Preparedness and Response Supplemental Appropriations Act, amounting to $8 billion, funded government agencies for direct public health support measures, such as research, review, testing and vaccines; economic disaster loans; and several international efforts.

The Families First Coronavirus Response Act (FFCRA), amounting to around $192 billion, was divided between expenditure increases and tax reductions. Major measures included increased public health funding for testing, extended unemployment

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[8] *IMF. (2021, July 2). Policy Responses to COVID19. International Monetary Fund. Retrieved January 18, 2023, from https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U.*
[9] *Dean, Phil. May 2022. The Unprecedented Federal Fiscal Policy Response to the COVID-19 Pandemic and Its Impact on State Budgets. University of Utah*

insurance benefits and escalated Supplemental Nutritional Assistance Program. The Internal Revenue Service income tax filing deadline was deferred from 15 April to 15 July, which on the one hand, secured cash flow support for households and firms remitting taxes, but on the other hand, resulted in fiscal problems for states as it shifted a significant portion of tax revenue from 2020 to 2021.
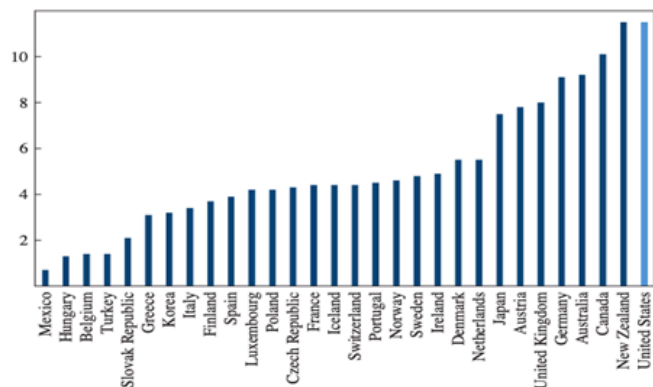

Figure 5: Early Pandemic Fiscal Packages in OECD Countries (as a share of the country's 2019 GDP), ordered from lowest to highest.
Source: Brookings Papers on Economic Activity, SPRING 2021, (SPRING 2021), pp. 89-110

The $1.7 trillion Coronavirus Aid, Relief, and Economic Security Act (CARES Act), the biggest Wave 1 bill, gave way to enormous fiscal policy stimulus through several programs and supported vulnerable businesses in surviving the crisis without the huge layoffs. State and local governments gained from the relaxations in the new Coronavirus Relief Fund ($150 billion). The Act provided funds to K-12 and higher education institutions, accounting for 2–3 times the standard yearly funding, relieving some burden from state budgets. The Paycheck Protection Program enabled grants to firms that retained employees in the early pandemic and the Economic Injury Disaster Loans facilitated low-interest working capital loans, with both programmes amounting to $1.1 trillion. The Act also provided households below determined income levels with economic impact payments of up to $1,200 per adult and $500 per child.

The Paycheck Protection Program and Healthcare Enhancement Act (PPPHCEA) heightened business PPP funding allocations by nearly $320 billion. The

bill also laid out $75 billion in increased hospital funding and $25 billion for testing.

The $0.9 Trillion Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA), announced in Wave 2, devoted more fiscal support, majorly through previously created routes. Major provisions included over $300 billion for increased business support and about $120 billion for facilitating unemployment insurance benefits.

Wave 3 of $1.9 Trillion was announced in March 2021. The American Rescue Plan Act (ARPA) laid out nearly $1.9 trillion in expenditure and tax reforms, which made it the largest fiscal policy support bill in history. Major provisions included over $410 billion in economic impact payments to individuals and $350 billion in relief to state, local, territorial, and tribal governments.
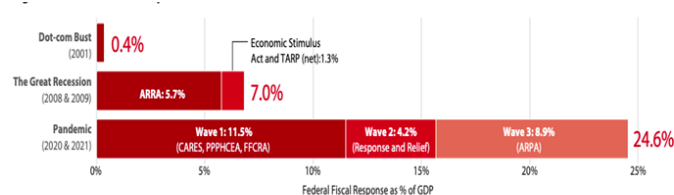

Figure 6: US government's fiscal policy response to recent recessions as a percentage of U.S. GDP
Source: Dean, Phil. "The Unprecedented Federal Fiscal Policy Response to the COVID-19 Pandemic and Its Impact on State Budgets." University of Utah, May 2022. https://gardner.utah.edu/wp-content/uploads/Fiscal-Stimulus-May2022.pdf?x71849

Figure 6 summarizes the three waves of fiscal policy responses to Covid-19 and depicts a comparison with fiscal responses during The Great Recession and the Dot-Com Bust.

As demand significantly increased, driven by consumer flush with cash, the federal government's policy response was successful in allowing businesses to retain employees and even hire additional employees. Consequently, the state's income tax revenues increased. Personal income rose by 8% in the second quarter of 2020, benefitting from unemployment benefits and cash transfers.

But on the other hand, the US government's massive fiscal response also put into motion future economic

and state budget issues, including inflation and increased debt. The most significant short-run result is that the fiscal policy response has contributed to the present inflationary pressures, with U.S. consumer inflation increasing to levels not seen in the past four decades. Further, if a wage-price spiral takes place, there is speculation about long-term inflationary challenges.

Furthermore, as interest rates increase while recovering from the pandemic, rising government debt service payments could possibly lead to fiscal challenges, which may negatively affect states, as the increased interest payments eventually crowd out other government spending.

Figure 7 plots the actual and estimated debt-to-GDP ratios of the US government, from 1962 to 2051. As expenditure due to ARPA has its full effect, the debt-to-GDP ratio is estimated to hit 110 per cent by the end of 2023.
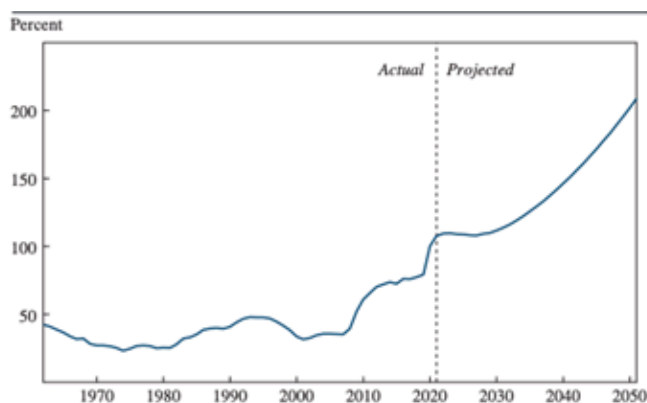

Figure 7: Actual and Projected US Federal Debt-to-GDP Ratio
Source: Romer, Christina D. "The Fiscal Policy Response to the Pandemic." *Brookings Papers on Economic Activity*, 2021, 89–110. https://www.jstor.org/stable/27093821

The significant increase in the debt-to-GDP ratio would lead to a reduction in fiscal space. Thus, the US may find increased opposition to expenditure on other urgent issues such as climate change.

Conclusion

Since the beginning of the pandemic, the fiscal policy cushioning the blow, supporting vulnerable groups and the healthcare sector and later targeting investment for an economic revival. However, emerging market economies and low-income countries' responses were constrained due to their limited fiscal space and pre-existing economic challenges. In terms of GDP, emerging market nations' budgetary measures were barely one-fifth the size of advanced economies by the middle of May 2020. [10]

While fiscal policy measures did provide much-needed relief to households and businesses, and also alleviated the contraction in economic activity, it simultaneously created inflationary and debt challenges that need to be resolved.

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[10] *Alberola, E. , Arslan, Y. , Cheng, G. , & Moessner, R. (2021). Fiscal response to the COVID-19 crisis in advanced and emerging market economies. Pacific Economic Review, 26(4), 459–468. 10.1111/1468-0106.12370*

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Impact of Macroeconomic Variables on Foreign Direct Investment (FDI)

Harsh Narain, Shreyas Mukherjee, Bharat Mahesh

Abstract

Foreign Direct Investment is an indicator of the investments made in India by investors, companies or governments of another country. It is important for the growth of an economy. This paper focuses on the impact of the Inflation Rate, Real GDP Growth Rate, Trade Openness, Exchange Rate and Real Interest Rate on Foreign Direct Investment in India. Using the data on the above-mentioned variables, collected for the years 2001-2021 from the open source website of the RBI, the paper focuses on finding a correlation between FDI and each of the macroeconomic variables considered in this paper. Further, an econometric model has been used and the data has been analysed through Microsoft Excel. The results of the study show a correlation between the exchange rate and the macroeconomic variables. However, the econometric analysis rules out the impact of the real interest rate on the Foreign Exchange Rate of India.

Keywords: Foreign Direct Investment, Exchange Rate, Inflation Rate, Real GDP Growth Rate, Stability, Real Interest Rate

Introduction:

Foreign Investment is of two broad types- Direct and Indirect. Direct investment gives direct ownership to the investor. When an investor spends to get direct ownership of assets in another country, the investment is called FDI. A rapidly expanding economy and a stable political administration and other factors that lead to booming markets with high demand are the factors that make a country attractive to foreign investors. The plethora of benefits that FDI brings itself incentivises the country to attract foreign investors. In this way, the country where investment takes place benefits and so does the country whose residents the investors are. FDI is a major component of economic cooperation and global integration as it forges long-lasting ties between various economies. International organisations like United Nations Conference on Trade and Development (UNCTAD) and World Trade Organisation (WTO) have prioritised FDI and have functioned towards helping developing countries attract foreign inflow.

India has reaped the benefits of rapid FDI inflow, especially after the restructuring of the economy in the 1990s. The country faced a major Balance of Payments (BOP) crisis in the 1980s due to the government's policy of Licence Raj and closed economy, making it nearly impossible for foreigners to invest. The Liberalisation policies undertaken in 1991 led to a drastic shift in the economy from a protective system to an open economy.

FDI is an economic factor that is dependent on various factors. So, it becomes necessary to understand what the factors are. Some of the important macroeconomic factors, that are a part of this study are Rate of Inflation, Growth Rate of Real GDP, Trade Openness, Exchange Rate and Real Rate of Interest.

Rate of Inflation

Inflation has been a major irritant for many economies across the world. High inflation has been seen as a detriment to an economy's growth and the welfare of its people. However, its role in affecting Foreign Direct Investment has been debated. This is further discussed in the next section.

Growth of Real GDP

Gross Domestic Product (GDP) taken after the adjustment of prices is Real GDP. Both FDI and Real GDP growth affect each other to some extent. Countries with high Real GDP growth generally see higher FDI inflow as compared to low-growing economies. This has been due to the greater scope of making profits there. Growing economies also have a large market. This makes them suitable for foreign investment.

Trade Openness

Taxes, Import and Export duties, Customs Duties, etc. come in the purview of openness of Trade. It has been obvious that high duties disincentivise investors to invest in a country. When their products are taxed at huge amounts their products see low demand in the country, making it unprofitable for them to invest. For example, the PLI scheme of the Indian Government has put a 100 per cent import duty on cars of Tesla. This has been a leading cause of Tesla not investing in the country besides lesser demand. Special Economic Zones are now being provided to facilitate foreign investment in the country.

Exchange Rate

The stability of a currency has been considered essential for FDI. It provides a suitable environment for investment. Foreign investors are generally reluctant to invest in a country having a volatile currency. Some theories suggest that a weak currency of a country encourages investment in it as the investors find it cheaper to invest and have more opportunities to augment their revenues. Though some theories highlight the positive impact of a strong currency on FDI. It is still debated whether a strong currency or a weak currency has a positive impact on FDI.

Real Rate of Interest

A real interest rate is determined by adjusting the nominal interest rate for prices. Any investor or firm is concerned about real interest rate as it determines the amount they have to pay in terms of goods after borrowing. So real interest rate is an important part of an investor's cost. That is why a low real interest rate is considered important for attracting foreign investors. Hence, not only fiscal policy but a sound monetary policy also plays an important role in garnering investment from other countries.

Literature Review

Typically, the term refers to a corporate decision to buy a sizeable portion of a foreign company or to buy it all together in order to expand operations to a new area. The phrase is typically not used to refer to a stock purchase in a single overseas firm. FDI is a crucial component of global economic integration since it forges strong, long-lasting ties between nations' economies. FDI capital can account for a sizeable portion of the GDP of smaller and emerging nations.

Exchange Rate and FDI:

The research results given by Russ et al. add to the body of open-economy macroeconomics literature. One of the results of the model proposes that shared underlying macroeconomic variables may jointly impact the behaviour of foreign investors as well as the level and volatility of exchange rates. In this regard, Bacchetta and van Wincoop's research on exchange rates and commerce and the methodology and conclusions presented in this work are very similar. Together, the results suggest that investigations of the effects of exchange rate uncertainty on trade flows are prone to the same types of endogeneity problems as regressions of FDI flows on both movements in exchange rate levels and on proxies for exchange rate uncertainty, such as its variance.

Inflation Rate and FDI:

According to Sayek's dynamic modelling Individuals' purchasing power is reduced by inflation, which distorts the net rewards on investment and labour. CIA restrictions are used to inject the distortions into the model. The cost of investing during period t is reflected in the foregone consumption. While the benefit is shown in higher consumption in period t + 1 due to more capital that has not been depreciated and higher consumption in period t + 2 as a result of higher production in period t + 1.

The money needed to purchase finished items in period t + 2 is provided by the sales of commodities created in time t + 1. The net benefit of investing decreases as inflation increases because, during this time, inflation reduces the purchasing power of profits before they are transformed into consumption. This technique measures the direct detrimental impact of local and international inflation on domestic and international investment. The model's key prediction, which has empirical

ramifications, is that the actual effects[4] of nominal variables rely on the type of foreign investment (vertical or horizontal), the foreign investor's financing patterns, and the components of production's interchangeability.

The findings also highlight the significant role that FDI plays in reducing the severity of inflation's negative real impacts. This conclusion adds to the body of research supporting the potential advantages of permitting more capital account liberalisation and FDI flows freedom.

Real GDP growth rate and FDI:

In a sample of 31 developing nations spanning 31 years, [5]Hansen et al. examined the Granger causal linkages between foreign direct investment (FDI) and GDP. We discover bi-directional causality between the FDI-to-GDP ratio and GDP level using estimators for heterogeneous panel data. GDP does not have a long-term effect on the FDI-to-GDP ratio, whereas FDI has a lasting impact on GDP.

Trade Openness and FDI:

Open markets for trade benefit FDI inflows. India and Pakistan, with the exception of Iran, have seen an increase in trade openness during the past five years (from 2008 to 2012), but FDI inflows have decreased over the same period for India, Iran, and Pakistan. All three nations have distinct borders, diverse governmental structures, and distinct monetary systems.

At first, the world's developing nations adopted trade-restrictive policies, but as time goes on and globalisation takes hold, all nations now see the value of trade liberalisation. Trade between nations is a major factor in both industrialization and technological advancement. The degree of trade policy liberalisation is significant since it has an impact on economic activity and output levels. International investors are always willing to put their money into countries with good infrastructure, markets, and policies. Therefore, foreign direct investment (FDI) inflows are solely caused by the environment of the host country.

Fiscal Deficit and FDI:

Findings from the EEC economies show that India needs to invest heavily in infrastructure development in order to receive sustained FDI flows, even if it means a trade-off with higher government deficits in the short to medium term. Since large-scale privatisation is not on the radar, this is true even if it means higher government deficits in the short to medium term. The role of fiscal responsibility could very well become crucial in recruiting FDI in the near future for the growing European economies, whose corporate sector is currently facing an immense struggle due to a demand deficit.

Research Methodology

The methodology used in the paper is primarily based on a collection of secondary data from credible sources like the open-source database of the Reserve Bank of India and the World Bank. The data was collected on the Foreign Exchange Rate of the Indian Rupee with respect to USD, Inflation rate, Real GDP Growth Rate, Interest Rate, Trade Openness (total value of exports and imports as a percentage of GDP) and Foreign Direct Investment.

The data collected was for 21 years, from 2001 to 2021.

Firstly, descriptive statistics have been used to check whether a correlation between FDI and each of the macroeconomic variables exists or not. The correlation between exchange rate and FDI has been analyzed through Karl Pearson's Correlation Coefficient

Further an Econometric Model for the dependent variable (foreign direct investment) in terms of the independent variables except for foreign exchange rate (other macroeconomic variables considered).

$$\hat{Y} = \beta_0 + \beta_1 z_1 + \beta_2 z_2 + \beta_3 z_3 + \beta_4 z_4$$

where $\hat{Y}$ is the dependent variable and z_1, z_2, z_3, z_4 and z_5 are the independent variables.

z_1 = Inflation Rate

z_2 = Real GDP Growth Rate

z_3 = Trade Openness

z_4 = Real Interest Rates

Hypothesis

1. Null Hypothesis, H0: Foreign Direct Investment is not affected by other macroeconomic variables ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$)
   Alternative Hypothesis, HA: Foreign Direct Investment is affected by at least one of other macroeconomic variables ($\beta i \neq 0$, for i = 1, 2, 3, 4)

2. H_1: Inflation Rate does not have[4] any impact on Foreign Direct Investment ($\beta_1 = 0$)
H_{A1}: Inflation Rate has an impact on Foreign Direct Investment ($\beta_1 \neq 0$)

3. H_2: Real GDP Growth Rate does not have any impact on Foreign Direct Investment ($\beta_1 = 0$)
H_{A2}: Real GDP Growth Rate has an impact on Foreign Direct Investment ($\beta_2 \neq 0$)

4. H_3: Trade Openness does not have any impact on Foreign Direct Investment ($\beta_3 = 0$)
HA_{A3}: Trade Openness (as a % of GDP) has an impact[5] on Foreign Direct Investment ($\beta_3 \neq 0$)

5. H_4: Real Interest Rate does not have any impact on Foreign Direct Investment ($\beta_4 = 0$)
H_{A4}: Real Interest Rate has an impact on Foreign Direct Investment ($\beta_4 \neq 0$)

Here,
β_1 = Partial Slope of Inflation Rate
β_2 = Partial Slope of Real GDP Growth Rate
β_3 = Partial Slope of Trade Openness
β_4 = Partial Slope of Real Interest Rate

Confidence Level and Level of Significance

Level of Significance, $\alpha = 10\%$ or 0.10
Confidence Level, $\beta = 90\%$ or 0.90

Data Analysis

Further, the data was organized in the form of a table in Microsoft Excel in order to analyze the mean values of each of the above-mentioned variables. After categorizing the variables, multiple linear regression has been applied.

Formula and calculation

Table 1

	FDI ($ Billion)	Exchange Rate of INR (w.r.t USD)	Inflation Rate (%)	Real GDP Growth Rate (%)	Trade Openness (Exports + Imports as a % of GDP)	Real Interest Rates (%)
Average	28.128 18804	55.19563333	0.062365 429	0.06075623 8	43.23337619	4.604736087
Correlation		0.767799028	0.232699 68	-0.16725796	0.337916639	-0.403332
Co-Variance		153.8841316	0.110694 522	-0.10068131 4	49.63406819	-19.89292495

Table 2: Regression Statistics

Multiple R	0.487284952
R Square	0.237446624
Adjusted R Square	0.04680828
Standard Error	17.42387345
Observations	21

Table 3: ANOVA

Table 3.1

	df	SS	MS	F	Significance F
Regression	4	1512.534017	378.1335041	1.24553 4447	0.331509539
Residual	16	4857.461855	303.5913659		
Total	20	6369.995872			

Table 3.2

|	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 90.0%	Upper 90.0%
Intercept	26.55570712	31.92139 702	0.8319093 02	0.417 70393 6	-41.1146 3157	94.2260 4582	-29.175 33885	82.2867531
Inflation Rate (%)	-141.1347015	227.0718 112	-0.621542 149	0.054 29980 59	-622.505 4373	340.236 0343	-537.57 56699	255.306266 9
Real GDP Growth Rate (%)	-122.9678069	118.3218 323	-1.039265 574	0.031 41324 4	-373.798 8862	127.863 2724	-329.54 39625	83.6083486 5
Trade Openness (Exports + Imports as a % of GDP)	0.659724355	0.741884 55	0.8892547 43	0.038 7041	-0.91300 0633	2.23244 9343	-0.6355 1977	1.95496847 9
Real Interest Rates (%)	-2.318622087	1.864416 203	-1.243618 288	0.231 55365 6	-6.27100 7875	1.63376 3701	-5.5736 75901	0.93643172 7

Results and Analysis

Correlation between Foreign Direct Investment and the Macroeconomic Variables affecting it

This section analyses the results of descriptive statistics of the study - the correlation between the exchange rate and each of the macroeconomic factors considered in the study.
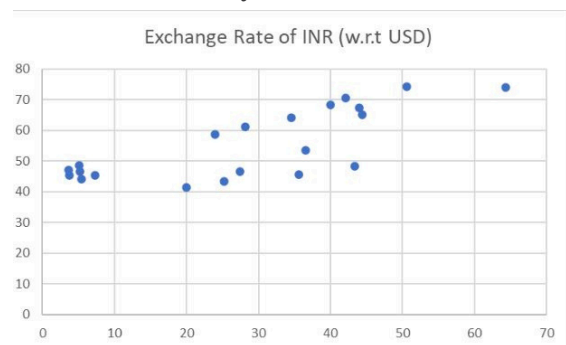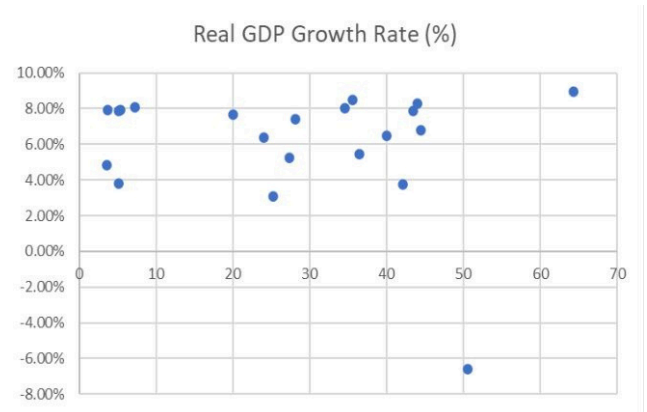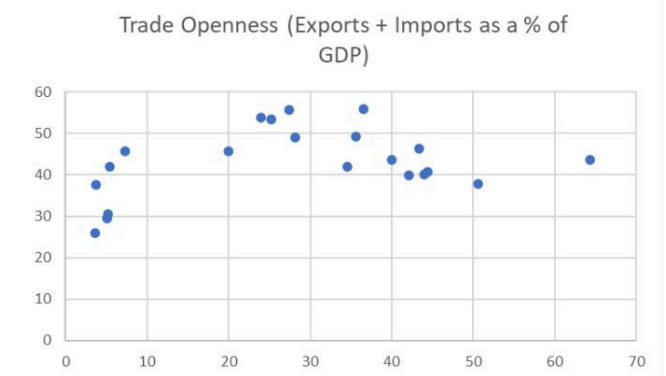

Graph 1
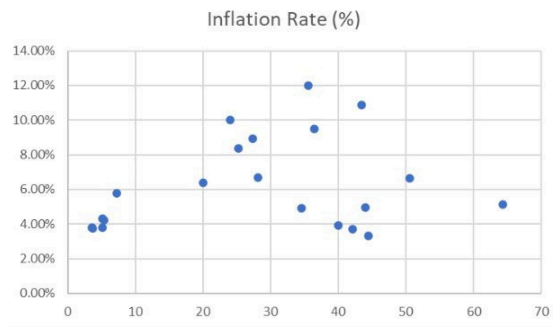
Graph 2

Graph 3

Graph 4

Graph 1 shows the scatter plot of the Foreign Direct Investment ($ Billions) of India and the Exchange Rate of the Indian Rupee w.r.t US Dollars for the years 2001-2021. From the graph, it is quite evident that the points are not scattered all over and are close to a straight line which suggests a strong correlation between the two variables. Moreover, on analyzing the data, the value of Karl Pearson's correlation coefficient, r, for these two variables came out to be 0.7677.

A high value of r confirms the strong relationship between Foreign Direct Investment and the Exchange Rate. Further, a positive value of the correlation coefficient also suggests that these two variables move in the same direction. This suggests that an appreciation of the INR w.r.t USD should lead to an increase in the value of Foreign Direct Investment in the Indian Economy. Further, the average value of INR w.r.t USD over the time period of 2001-2021 was 55.19 which is significantly lesser than the current value of INR in terms of USD.

Graph 2 shows the scatter plot of the Foreign Direct Investment (to India) and the Inflation Rate of India. On analyzing the data, the value of Karl Pearson's correlation coefficient, r, for these two variables came out to be 0.232. This is a moderately low value of r and it confirms that there exists a weak relationship between Foreign Direct Investment and the Inflation Rate. Further, a positive value of the correlation coefficient also suggests that these two variables move in the same direction. This suggests that an increase in the inflation rate should lead to an increase in the value of Foreign Direct Investment in India.
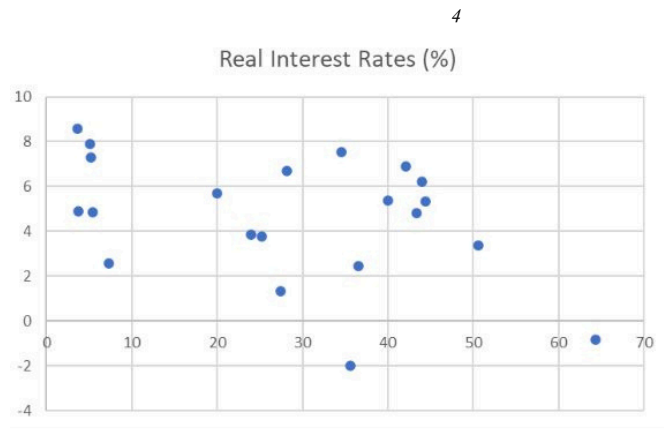
Graph 3 depicts the scatter plot of the Foreign Direct Investment of India and the Real GDP Growth Rate of India for the years. The value of Karl Pearson's correlation coefficient, r, for these two variables, came out to be -0.167. This is a low value of r and it confirms the weak relationship between Foreign Direct Investment and the real GDP growth rate. Further, a negative value of the correlation coefficient also suggests that these two variables move in opposite directions. This suggests that an increase in the real GDP growth rate led to a decrease in the value of Foreign Direct Investment in the given time frame.

Graph 4 depicts the scatter plot of the Foreign Direct Investment and the Trade Openness of India. It is evident from the graph that the points are relatively less scattered but do not lie in a straight line. The value of Karl Pearson's correlation coefficient, r, for these two variables, came out to be 0.33. This is a moderately low value of r and it confirms the moderately weak relationship between Foreign Direct Investment in India and Trade Openness.

Thus, it suggests that the removal of trade barriers leads to an increase in Foreign Direct Investment in India for the years 2001-2021.

4

Graph 5

Graph 5 depicts the scatter plot of the Foreign Direct Investment and the Real Interest Rate of India. It is evident from the graph that the points are relatively less scattered but do not lie in a straight line. The value of Karl Pearson's correlation coefficient, r, for these two variables, came out to be -0.40. This is a moderately low and negative value of r and it confirms the moderately weak and inverse relationship between Foreign Direct Investment in India and Trade Openness.

Results of Econometric Analysis

From Table 2, the value of R Square obtained is 0.237 which is considered to be low. This explains that roughly 23.7% of the variability in the Foreign Direct Investment of India can be explained through the set of independent variables for the given time period of 2001-2021. Thus, the macroeconomic variables - inflation rate, real GDP growth rate, trade openness and real interest rate together do not have an extremely considerable role in determining the variability of Foreign Direct Investment. In addition to this, the adjusted R square which is adjusted according to the number of independent variables shows the correlation between the dependent and independent variables. In this study, the value of the adjusted R square is 0.046. This shows a very low level of correlation between the exchange rate and the independent variables mentioned above. However, this low value can be attributed to the small sample size.

Further, the level of significance for this study is taken as 10% or 0.10 and the value of Significance F is 0.33 (refer to Table 3.1). Theoretically, if the value of Significance F is less than the level of significance,

then we do not fail to reject the null hypothesis. In this study, the null hypothesis is that the partial slopes of all independent variables are zero and thus Foreign Direct Investment isn't dependent upon the variables which are considered independent. However, this is now rejected which suggests that the Foreign Direct Investment is dependent upon at least one of the independent variables. This means that the partial slope of at least one of the variables is not equal to 0.

However, the value of Significance F does not give any conclusion about which of the independent variables are significant for the study and which are not.

Thus, the results of the p-Value in Table 3.2 are considered.

Again, the level of significance is 10%, i.e., 0.10.

The p-value of the inflation rate is 0.054 which is less than 0.10. Therefore, the null hypothesis that the inflation rate does not impact the Foreign Direct Investment is rejected. Thus, the inflation rate has an impact on the exchange rate for the years 2001-2021.

The p-value of the real GDP growth rate is 0.031 which is less than 0.10. That is, the p-value of the real GDP growth rate is less than the level of significance. So, the null hypothesis that the real GDP growth rate does not have any impact on Foreign Direct Investment is rejected. Thus, the real GDP growth rate has an impact on the Foreign Direct Investment for the years 2001-2021.

For Trade Openness, the p-value obtained from the study is 0.038, which is less than the level of significance of this study. Therefore, the null hypothesis which states that trade openness does not have an impact on Foreign Direct Investment is rejected. Thus, the fiscal deficit has an impact on the Foreign Direct Investment of India for the years 2001-2021.

The p-value of the real interest rate is greater than the level of significance and thus the null hypothesis is accepted. So, the null hypothesis is accepted that the real interest rate does not have an impact on foreign direct investment.

From the analysis, the values of the intercept and partial slopes are as follows:

β_0 = 26.55570712
β_1 = -141.1347015
β_2 = -122.9678069
β_3 = 0.659724355
β_4 = -2.318622087

Conclusion

1. Using Karl Pearson's Correlation Coefficient, this study concludes the following:
- There exists a moderately low and positive correlation between the Inflation Rate and Foreign Direct Investment for the years 2001-2021.
- The correlation between the Real GDP Growth Rate and Foreign Direct Investment is moderately negative.
- Foreign Direct Investment and exchange rate have a high and positive correlation.
- Foreign Direct Investment and Trade Openness are positively correlated and the degree of correlation is moderately low.
- Real Interest Rate and Foreign Direct Investment are negatively correlated and the degree of correlation is moderately high.

2. Results of Econometric Analysis are mentioned below:
- H0 is rejected and thus HA is not rejected. This concludes that at least one of the variables impacts Foreign Direct Investment.
- H1 is rejected which implies that HA1 is not rejected. This concludes that the inflation rate has an impact on the Foreign Direct Investment of India.
- H2 is rejected and thus HA2 is not rejected which implies that the Real GDP Growth Rate has an impact on the Foreign Direct Investment of India
- H3 is rejected and thus HA3 is not rejected. This implies that Trade Openness has an impact on the Foreign Direct Investment of India.
- H4 is not rejected and thus HA4 is rejected. This implies that for this study, the real interest rate does not impact the exchange rate of INR and SDR.

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Misleading Statistics: Influencing Opinions With Numbers

Gopal Saraf & Pulkit Bansal

Abstract

They say numbers don't lie, but sometimes they might tell half-truths. They can be used to mislead a person to make incorrect perceptions and decisions. The scope of misleading statistics goes far and wide, and this paper tries to highlight a variety of methods in which numbers can change the perception of any generic situation you might encounter in real life and explains them through comprehensible examples. The paper first discusses a variety of statistical fallacies and phenomena, which might arise in different stages of the statistical process, from collection and processing to the final presentation of data. The next part involves a self-undertaken analysis of the extent of transparency in consumer brand claims, both statistical and scientific. Finally, it provides certain suggestions to enhance the statistical abilities of readers to avoid a variety of statistical fallacies and paradoxes and become informed consumers. We aim to conduct a thorough analysis of a variety of common and uncommon statistical phenomena, their impact on an overall study and indirectly on influencing public opinion, trying to inform the reader about the basic number games that might be played on him by corporations, governments and individuals, and how one can identify and avoid them.

Introduction

"There are lies, damned lies and statistics" is a famous quote by Mark Twain. This is a phrase describing the persuasive power of statistics to bolster weak arguments and doubt the statistical methods used by another person to justify their stance.

Did you know that 23.7% of statistics are false? Is this true? Well no, this is just a made-up number. The extent and scope of misusing statistics like this are pretty much endless, either intentionally or accidentally. The ignorance of various statistical phenomena that are crucial to understand before undertaking a research study can lead a researcher towards a dead-end. The impact of such phenomena on research studies needs to be analysed to understand the deviations these can cause from the actual result.

We observe statistics in our daily life. But we don't know which stat is genuine or which phenomena or methodology led them to reach that conclusion and even if that methodology was free from any bias or error. They have a huge but unrealized impact on the human psyche. Backing up a generic statement with numerical proof or statistical evidence provides authenticity to the data, which gives an incentive to the other party for misusing them. Be it politics or advertisements by corporations, presenting statistics in a distorted manner is a convenient strategy to mislead the public. The major rationale behind running a misleading campaign is the lack of resources available to the public to verify the claims portrayed with the advertising. As Kariyawasam & Wigley (2017) concluded in their study, "Marketers should avoid deceptive practices because these are harmful to their customers and, ultimately, their businesses."

Just imagine you see a quite strong numerical claim on the package of a product followed by an asterisk. How many times will you take the effort to see the text written in barely readable size at the back of the product to read the condition of that claim? And to even understand the complete rationale and methodology of that one-line explanation, how many times will you take the effort to go to the company's website and read the entire list of qualifiers that the company has put in to reach that 'completely truthful' claim? Most of the time you won't. But if the brands want to throw numbers at the customers to sway them by making such claims, it's their responsibility to have transparency by providing them with proper statistical evidence. The understanding of statistics

plays a huge role in identifying the flaws in studies and surveys that are undertaken by a variety of organizations for misleading intents.

Statistical Phenomena and Fallacies

Statistics is the mathematical discipline to collect, summarise and display data. Playing with numbers and data can lead to some interesting observations, some of which can be incorrectly interpreted due to the subjective nature of the analysis. Consider the following statements: We interviewed 1000 people who played Russian roulette. All of them survived, hence it is concluded that Russian roulette is a completely safe game to play. Based on surveys and observations, it can be inferred that violent television shows make a child more violent. Is this really true? People with bigger feet are better at mathematics. If the interest rates on deposit increases from 5% to 10%, will this be considered a 5% increase or a 100% increase in interest rates? Mere common sense helps us to understand that these statements cannot be true. So where is the error of perception here? All these statements show some form of statistical discrepancies through a simplified conclusion. The incorrectness of these statements can be identified by mere judgement here, however, an individual would not be able to identify these same errors if they occur in more sophisticated situations, involving larger datasets and complex analysis.

Now, we would begin the analysis of different statistical phenomena and fallacies that can take place at various stages of a statistical study through real-world situations.

Data Collection

Data collection is the first stage of a research study and there can be various unidentified biases that can creep in right at the beginning, which can compromise the entire study. Sampling might involve selective or purposeful biases, like choosing a particular set of people, omitting some variables or posing misleading questions which would usually lead to a single answer; aiming to prove a statement correct and deriving the particular conclusion that one desires. When this is combined with the overgeneralization of the population parameters with the already biased sample, it leads to certain results which don't accurately represent the general population; leading to faulty findings and unjustified conclusions.

Drawing conclusions from a sample data set that isn't representative of the population being analysed is another sampling bias. A classic problem of surveys and polls is that people taking part in a survey are not representative of the total population, either due to self-selection or bias from the analysts, which leads to faulty conclusions. If the popularity of a trendy product is calculated based on the responses from a younger sample only, this cannot reflect how the product is perceived by the whole population of various age groups.

The approach of questionnaire framing for a survey should be looked into before interpreting the results hastily. For instance, consider the questions:
 1. "Do you believe that you should be taxed so other citizens don't have to work?"
 2. "Do you think the government should help those people who cannot find work?"

These are loaded questions that might use an implicit and unjustified assumption to collect responses in a biased manner. A more accurate question would be "Do you support government assistance programmes for unemployment?" Similarly, leading questions and double-barreled questions (measurement of two factors in one question, like satisfaction) might be used to lead the respondent to select an option intentionally. Keep in mind that these problems can arise knowingly or unknowingly in a survey but it is the duty of the surveyor to avoid them and ultimately justify the results.

There is another fundamental bias which affects statistical results- The Hawthorne effect. This effect states that subjects of a study (or a survey) attempt to change or enhance their behaviour, ideas and predicted actions; simply because they are being evaluated and observed. A person who supports party A in a clear party B-dominated constituency wouldn't openly say so to a pollster, or even a person who undertakes open dumping of waste won't openly admit this when questioned in a survey format. This is because these practices are something that society condemns, and an individual has an image to uphold

in front of the surveyor and society in general. Thereby they would agree with the conventional answer that is expected out of them, which however isn't accurate. Even if the survey finds that only 30 percent of the sample collected engages in open dumping of waste, this number is not fully accurate accredited to the presence of the Hawthorne effect, and the fact that this information collected cannot be verified by the surveyor, who has to rely on the judgement and truthfulness of the respondents.

Survivorship Bias is an intriguing type of selective bias, which presents a skewed and incomplete picture of the situation as the sample set contains only those outcomes that have survived some selection criteria. This leads to assessing only the successful outcomes and disregarding the unfavourable ones, in turn leading to incorrect conclusions since only a subset of the population has been considered. Consider while determining the correlation between becoming a successful football player and dropping out of school, one may examine only highly successful football players like Messi and Ronaldo and ignore the aspiring players who couldn't succeed despite dropping out, along with the players who succeeded even after completing their higher studies. Thus, observing only a selected sample of successful outcomes based on a particular criterion will generate skewed results as they are not a true representation of the population. The survivorship bias can be avoided by clearly observing and identifying the sample set of your study before proceeding with the analysis. A true representative sample of the population has to be drawn in order to overcome this bias.

Data Processing

Sometimes researchers, while analysing large amounts of data, might find a correlation between any random elements, but fail to acknowledge that the correlation could be a result of chance. This is called data fishing. When data analysis is done without a predetermined research question, the likelihood of misleading findings escalates. Tests for statistical significance only work if the hypothesis of your study is defined upfront. Historically, this has been a problem with clinical trials where researchers have 'data-dredged' their results and switched what they were testing for, which subsequently leads to

many of these studies being disproved.

A couple matching the description of a pair of burglars is caught, and it is calculated that there is less than one in a million chance that the couple might be innocent, hence they are announced guilty. The result here is due to a simple misunderstanding of conditional probability and is called the Prosecutor's fallacy. The prosecutor argues that there is only a one-in-a-million chance that the accused would match the description of this type (say event A) if innocent (say event B) and concludes that the accused is guilty. The prosecutor has quoted $P(A|B)$ when it is $P(B|A)$ that should be considered. This fallacy has contributed towards innocent individuals being sentenced guilty and is relevant in understanding how a simple mix-up of numbers might lead to disastrous consequences. It can also be used to explain the Russian Roulette situation given above (along with survivorship bias), where we have considered P(Played Russian roulette| Person survived) instead of P(Person survived| Played Russian Roulette).

Sometimes while processing the data, it is observed that the same set of data can show opposing trends, depending on how it's grouped. The Simpson's paradox is a statistical phenomenon where the association between two variables emerges, disappears or even reverses directions when the population is divided into different subpopulations. This method of grouping data based on prejudices to prove a certain point is often used to display (biased) results. Statisticians simply divide data into groups as per their convenience, and the numbers obtained can thereby be used to defend either of the arguments they choose, by simply omitting the other set of numbers in their presentation.

A prominent case illustrating Simpson's paradox can be inferred from the table given below. In the 1970s, Berkeley University was accused of sexism due to the overall less acceptance rate of female applicants. However, it was discovered that the acceptance rate for individual subjects was higher for women. The reason that the combined acceptance rate was lesser for female applicants was that they had applied for courses with an overall lower acceptance rate. The paradox was caused by a difference in what subjects
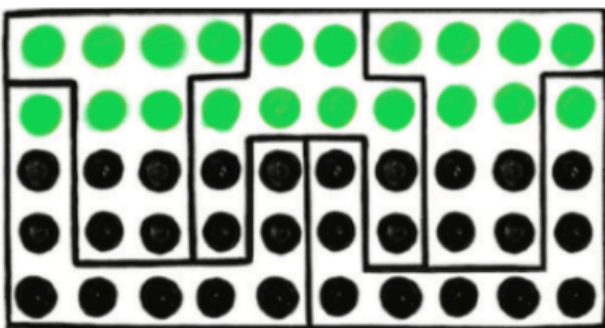
men and women were applying for.

APPLICATION SUCCESS RATE

	MALE	FEMALE
SUBJECT 1	14 % (168 of 1200)	15 % (270 of 1800)
SUBJECT 2	50 % (400 of 800)	51 % (102 of 200)
TOTAL	28 % (568 of 2000)	19 % (372 of 2000)

Source: https://www.geckoboard.com/best-practice/statistical-fallacies/#cherry-picking

The given illustration explains how grouping is relevant in the case of elections (called gerrymandering), and can change the results significantly.
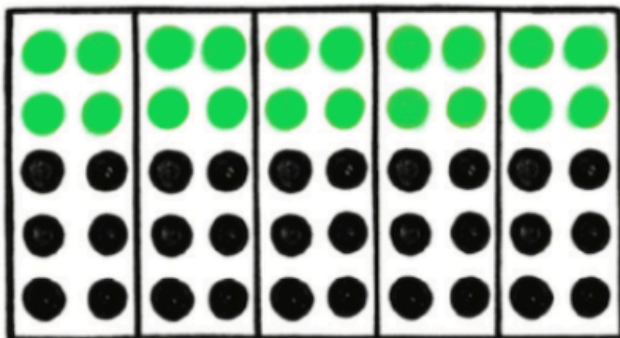
BLACK WINS

GREEN WINS

Source:https://www.geckoboard.com/best-practice/statistical-fallacies/#cherry-picking

Gambler's Fallacy is another interesting data fallacy referring to a gambler's mistaken belief that the probability of an event reduces if it has taken place more frequently than usual recently. This interpretation is based on the short-term applicability of the law of averages. Let's say a cricketer has scored 3 consecutive centuries. A gambler in this case would consider that the probability of the cricketer scoring a century in the next match is less as the law of averages would catch up and balance things out. However, the probability of a cricketer scoring a century in the next match remains the same irrespective of whether he has scored 3 consecutive centuries just before the succeeding match, as each match is an independent event and is not affected by the previous results.

On the other hand, Regression Towards the Mean is a statistical phenomenon that states when some extreme outcomes occur, they will revert to the average in the long run. This means that when something unusually good or bad happens, it will most likely return towards the average in the future. Now this phenomenon seems to be in contradiction with the Gambler's Fallacy. The major thing to note here is that Regression Towards the Mean describes the trend of future events while Gambler's Fallacy describes the probability of the immediate next event. Regression towards the Mean is concerned with long-run trends, while Gambler's Fallacy is limited to short-run outcomes. Hence, even though the probability of scoring a century in the next match remains the same, it can be stated that the trend of the future scores would be such that the batsman's expected score in each inning would be his average score. A batsman having an average of 45 runs per innings would be expected to score 45 runs per match in the future despite the fact that he scored 3 consecutive centuries recently. The expectation of each future event would be based on the average trend in the long run. The major point to note here remains that Gambler's Fallacy and Regression Towards the Mean are two separate statistical phenomena that solve different purposes and essentially are not contradictory in nature.

Data Presentation

Data can be presented in several ways and

data visualisation is one of its most prominent techniques. Data visualisation turns raw figures into visual representations of key trends, relationships, and patterns. However, this form of statistical interpretation has been misused for years, by politicians, companies and individuals to justify their stance, misleading the general public who are sometimes swayed by these huge gaps in graphs, not being able to plot and interpret the numbers themselves. Using an inappropriate scale, truncated axis or an unsuitable type of graph as per the person's convenience to display a picture that justifies their point of view is how these graphs use visuals to influence public opinion. An instance of this can be inferred from the graphs presented below, which show that the visual distance between two quantities increases upon taking a truncated axis, while the numerical difference remains the same.

Source- https://archive.aessweb.com/index.php/5004/article/view/4748/7555
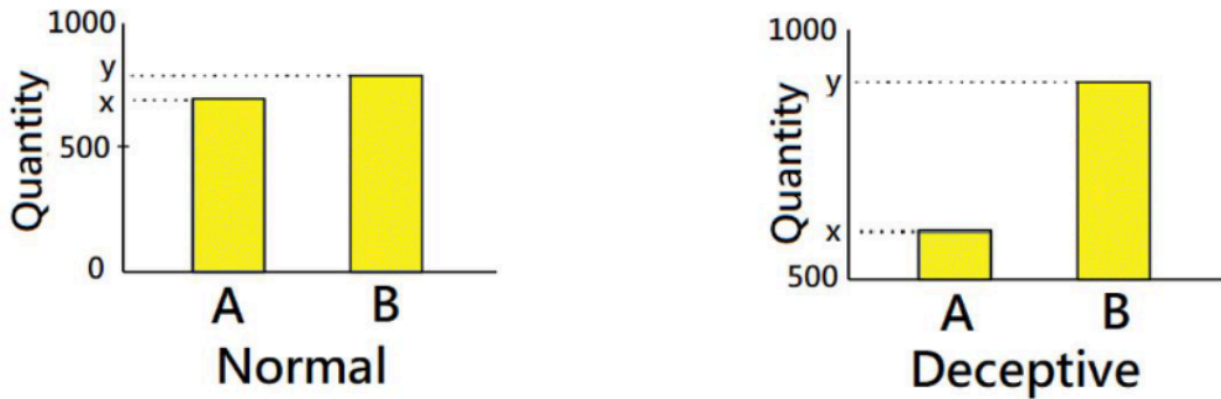
Correlation does not mean causation," is a basic but important concept in statistical analysis. It is numerically interpreted that violent television shows are likely to make a child have violent tendencies. What if the children who watch violent television shows are more violent themselves? This is a simple case of misunderstanding correlation and causation; just because more aggressive kids watch violent shows, doesn't mean that watching these shows would make a child violent.

Baldness raises the cardiovascular disease risk up to 70%! An instance of the third-cause fallacy is displayed by this statement, unveiling how effortless it is to misinterpret statistics. The statement confuses a spurious relationship for causation, omitting the third variable of old age and how it escalates the instances of both baldness & cardiovascular diseases.

The graph below highlights the post hoc fallacy of statistical analysis; plotting variables on the axes which have no direct relation with each other, showing a correlation between them, and trying to justify a causal relationship from a temporal one, which in fact doesn't exist.

Source- https://www.fastcompany.com/3030529/hilarious-graphs-prove-that-correlation-isnt-causation
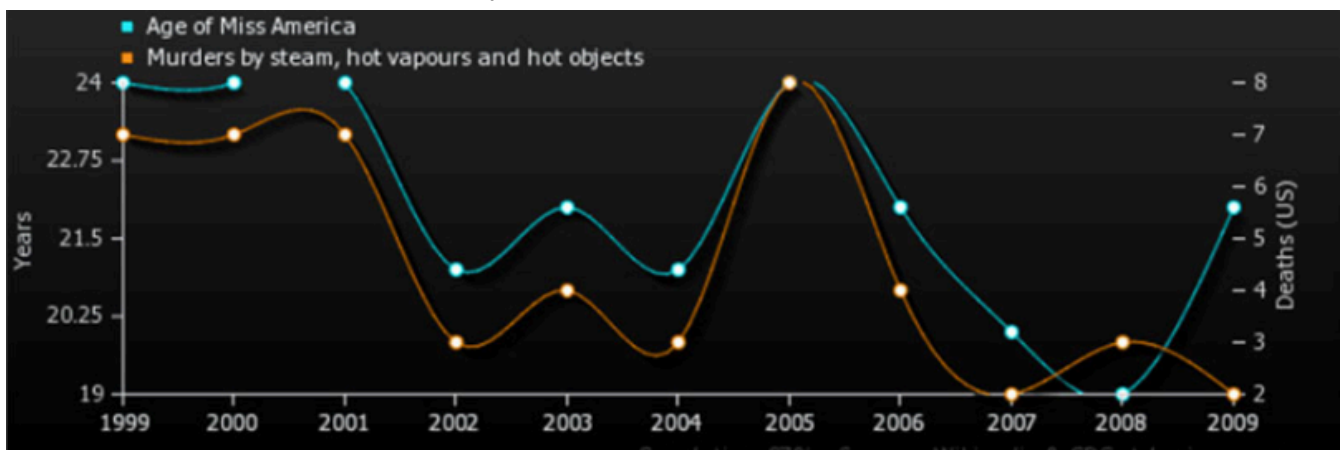
One study in the UK appeared to show that smokers had a higher survival rate than non-smokers, over a 20-year time period. However, upon taking a look at the sample set, it was observed that the non-smokers were significantly older on average, and hence more likely to die during the trial period; precisely because they were living longer in general. Age group is the hidden(omitted) variable here, which when specified, changes the entire result of the study. A similar result can be observed with the statement given above, that people having bigger feet are better at maths. This is because the sample set includes toddlers and children as well, and it is an obvious fact that knowledge of mathematics increases with age. This shows that before concluding any result, the sample should be thoroughly analysed for all their traits and factors which may seemingly affect the interpretations generated.

These various statistical concepts highlight how a lack of due diligence and precautions while undertaking a study can render all the efforts useless.

A Case Study: Consumer Brand Claims

Misleading statistics can be found across various fields and industries. But one of the most potent misuses can be observed in the case of consumer brands, which try to take advantage of statistical claims for advertising their products. Imagine a company undertaking a study or survey for its product to advertise the findings as a validation check that can lure customers into buying. The costs associated with undertaking such a study can be expensive because of the large sample size that is required to get any sort of real finding and conclusion. Now, if the finding of the study comes out to be unfavourable, these huge costs become sunk costs as the company cannot possibly advertise unfavourable results. The only choice they are left with is to manipulate and misrepresent the findings of the study, maybe through various qualifiers or omitting some important factor to present the statistic in a way that will be perceived by the public in a positive sense. This is the only way a company can make use of their study and investment since the opportunity cost of not utilising the study at all is high and of presenting the truth, even higher.

Healthcare is one of the most critical industries plagued with misleading campaigns by pharmaceutical and health service companies. The high barrier of entry of extensive investment and certification for new products is what creates a hurdle for companies, which look to surpass the validation check by presenting inaccurate facts or misleading claims to the public to quickly boost sales and recover their high investment. This strategy was at work, especially during the pandemic. Patanjali, for example, claimed to have developed an Ayurvedic cure for Covid-19, Coronil that claimed "100% favourable results", within 3 months since the pandemic set foot in India. This claim came at a time when scientists were still working towards the preliminary trials of vaccines and the fear factor among the general public was at its peak. Patanjali is one such brand which has had a long history of running misleading advertisements and claims, ranging from curing HIV to cancer. The Advertising Standards Council of India (ASCI) has pulled up the company end number of times over the years for their misleading claims related to several products.

Another intentional method of misleading the public is Optical Discounting. This refers to the pricing strategy where a company increases the MRP of a product and offers the product to the customer at the previous MRP, showcasing the difference as a 'discount.' This is one of the most lethal tools for misleading the public since there's no way a customer can identify whether the discount being offered to them is an optical discount or not.

Studying the Transparency of Product's Statistical Claims:

Transparency is a major issue when it comes to companies making unverified or misleading claims about their products. We took a small sample of 8 FMCG products to assess the transparency of statistical claims. Although it's unlikely that every customer will refer to the justifications or even pay heed to verify such claims, it's the responsibility of the company to provide proper backing for their claim on the packaging itself, or at least on their website; instead of presenting figures and numbers with no meaning and justification behind them, trying to explain these as "based on lab tests."

The following table summarises the list of products sampled and their respective claims and justifications on the packaging along with the categorisation of the evidence as ambiguous or explicit:

PRODUCT	CLAIM	JUSTIFICATION ON PACKAGE	EVIDENCE: AMBIGUOUS OR EXPLICIT
Cif Kitchen Surface Cleaner (Unilever)	100% Oil and Grease Removal	Based on lab tests	Ambiguous
Harpic Drain Xpert Powder (Reckitt Benckiser)	Unblocks in 30 minutes	As per lab tests on simulated clogs	Ambiguous
All Out Ultra (SC Johnson)	Kills Dengue & Malaria Mosquitoes 30% Faster	Knocks down 50% of dengue and malaria carrier mosquitoes faster based on lab tests	Ambiguous
Cinthol Healthy Soap (Godrej)	99.9% germ protection	As per the lab test on a selected organism	Ambiguous
Lifebuoy Soap (Unilever)	100% Stronger Germ Protection & 12 Hours of Freshness	-As per lab test on indicator organism vs soap bar without actives -Basis an independent study conducted in 2019	Ambiguous
Red Toothpaste (Dabur)	Clinically Proven Fights 7 dental problems	QR code linking to a detailed web page containing all the explicit details regarding the study and proof	Explicit
Dettol Liquid Handwash (Reckitt Benckiser)	10x better protection against germs	As per standard testing protocol against the bar and liquid soap without actives	Ambiguous
Almond Drops Hair Oil (Bajaj)	6x Vitamin E Nourishment	As compared to ordinary (unbranded) hair oil	Ambiguous

In sharp contrast to all the other examples, Dabur provides a QR code on the back of its Dabur Red toothpaste package providing a detailed explanation and results of the studies undertaken by Dabur on its website, even mentioning the place of study and from where the sample set was taken. The other I companies take the easy way out by just providing one-line justifications. If the companies have actually the mentioned lab tests and studies to make the claims that they are, why aren't they providing a detailed summary of these tests and studies on their websites along with the QR code for the same on products like Dabur? Just as in the Schrodinger's Cat experiment, a consumer won't know if the claim is true or not unless the company provides you with the details of the lab tests and studies. In the absence of that, you can only assume the genuineness of the claim based on your discretion and believability. Another way of determining the authenticity of the claim is to conduct lab tests and study of your own, which seems a far-fetched thought unless your curiosity transforms you to become a scientist. From the consumer perspective, they won't buy a Unilever or Dettol product just because of their opaque claims like "Kills 99.99% germs." The effect that such claims have on the psychology of a consumer doesn't seem substantial in the case of legacy brands which might be even exploiting the trustworthiness of their consumers. But companies certainly believe that a numerical claim has a greater influence on the customer psyche rather than a generic claim. With diminishing attention spans, even if a consumer pays heed to a claim on the package of a product,they would simply see whether it passes their check of realism or not. This is exactly the reason why companies don't take the effort of providing evidence for their claims. A company should ideally provide information regarding the sample set, including its characteristics and size, study methodology, observation and visuals for statistical claims, and lab test details for scientific claims to ensure an informed and satisfied consumer.

Avoiding Misleading Statistics

Statistics have the potential to be extremely resourceful, but misleading statistics can confuse and trick people. Statistics give authority to a statement and convince people to trust in a certain argument. As Trendel, Mazodier, & Vohs (2018) concluded in their research paper, "misleading information may confuse and trap people. It is necessary to recognize misleading data and their statistics." Misleading statistics are dangerous, instead of helping people to avoid pitfalls and potholes of fallacies, they lead people right into them. However, it is possible to identify misleading statistics and data. Whenever you come across a numerical statistic or survey, it's important to question the source of data, whether it is controlled or is it a sample size experiment, and consider the other factors that could have been the cause of this result; measuring the validity of the information and conclusion. Examine who is undertaking this research, the sample set's characteristics, whether the data visuals represent a fair picture or not and the language in which the research and ideas are presented. To prevent misleading data and statistics from polluting your reports, dashboards, and analytics, address new information with a curious and sceptical attitude. The increasing reliance on automated software for processing and drawing inferences from complex datasets has made it essential to adopt practices for due diligence like scaling the data and running a sanity check. These should be implemented prior to comparing data from different sources, datasets, times, and locations and running them through such software. Some more steps and precautions that can be undertaken to minimize the risk of generating misleading statistics are listed below:

1. Scrutinizing the methodology, and potential biases of the researcher or organization behind the data
2. Assessing the sample and its characteristics and whether it's a true representation of the target population
3. Checking the correlation and causation sanity and assessing all the factors influencing a particular parameter
4. Examining graphs and visuals to ensure fair representation at appropriate intervals
5. Ensuring proper organization and presentation of data to avoid distortion or misinterpretation
6. Collaborating with peers and institutions for validation and peer review along with educating oneself about best practices of data analysis.

Whether collecting data or viewing the results of others' research, be certain that the data is accurate. Through this, one can ensure that they are not adding to the spread of misleading statistics.

Conclusion

Various factors contribute to misleading statistics such as faulty correlations, selective bias, neglected sample size, and incorrect causations including the use of deceiving presentation of data through graphs and visuals. These factors can arise from intentional manipulation or unintentional errors like complacency and carelessness in data handling and incorrect interpretation due to ignorance.

Misleading statistics cause negative consequences in prominent areas, which include marketing campaigns that misrepresent product efficacy, scientific research that leads to incorrect interpretations, and political campaigns that manipulate the public and their opinions. This misinformation can result in consumer distrust, scientific failures, and policy inaccuracies.

As a consumer, it becomes increasingly important to know which brand or company might be lying to you so that you can also assess the best available product in the market. With increased scrutiny on the social responsibility aspect of businesses that includes the element of transparency and communication to the consumers, it becomes essential for companies to follow this principle by backing up their claims with detailed explanations rather than one-line quotes. Any research that is undertaken is bound to fall prey to some or other statistical paradox. It is extremely important to have a complete picture before undertaking any study or research and understand the presence of statistical phenomena and fallacies to avoid them.

Some can be avoided, some cannot, and it is difficult to take notice and recognise all of them. Dealing with numbers can be complicated and a small error can have a large impact.

Whether for market intelligence, information dissemination, customer experience, or business reporting, the future of data is now. Application and analysis of data should be undertaken responsibly, ethically, and visually, to increase its relevance and transparency.

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National Food Security Act: A Policy Critique

Shrish Dhuria

Abstract

Food security and nourishment policies in India are made in a framework defined by complex socio-economic variables which influence the expected intake of nutrition of any given beneficiary. Even as the National Food Security Act seeks to fulfil its listed objectives, it finds itself hindered by the prevailing challenges of income instability, stagnant agricultural productivity, unequal intra-household distribution, poor literacy and disparities along social lines. Therefore, recommendations to improve the efficiency of the Act and its constituent schemes and programmes may be made to secure the nutritional goals of this policy's intended recipients.

Introduction

The National Food Security Act, 2013 was implemented to ensure universal food affordability and availability among one of the largest malnourished populations, categorically utilising its agricultural surplus to be disseminated via a trident of public distribution systems.

However, as it stands, India ranks 71 out of 113 major countries in terms of the food security index 2020, and 43% of children are still chronically undernourished. Though the available nutritional standard is 100% of the requirement, India lags far behind in terms of quality protein intake at 20%, which needs to be tackled by making available protein-rich food products such as soybeans, lentils, dairy, etc at affordable prices.

Socio-Economic Challenges of Food Security in India:

Income Instability and Inequality:

- The primary cause of food insecurity is low income, with income-constrained households forgoing meals in favour of other essentials (Bartfeld & Dunifon, 2006). Food diversification among low-income groups in the country from cereal to non-cereal consumption habits borne out of income instability has caused the incidence of suboptimal health outcomes, with the vulnerabilities of nutritional inadequacies reflected the worst in male-headed households without regular income (Bhuyan & Sahoo, 2017).

- Despite high economic growth, high-income inequality undercuts the benefits of economic growth in reducing food insecurity. Moreover, results show that increases in the gross domestic product (GDP) per capita are concurrent with declines in individual food insecurity. Income inequality increases the likelihood of food insecurity, and where there is economic growth it undercuts the positive effect of economic growth on individual food security (Holleman & Conti, 2020)

- Among the worst of such groups by such assessment are: a) agricultural landless casual unskilled labour - rendering them entirely dependent on governmental food and work programmes without any asset or wealth creation capacities on their own to thrift and break the vicious cycle of rural poverty, and b) Its spill-over phenomenon - the urban poor.
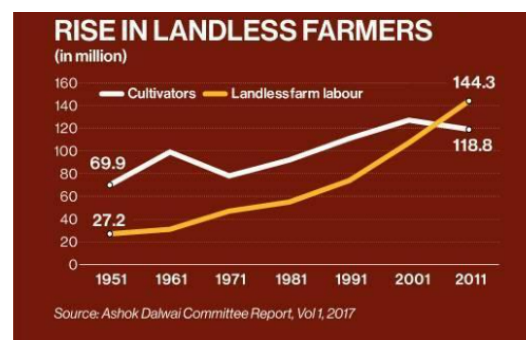

Figure 1: Increase in land inequity in India

Population Stress, Limitations of Agricultural Productivity and Inflation:

- Due to the sheer scale of the population at hand to be serviced and the fixed nature of land as an agricultural input in the economic conduct of nearly 60% of the working class - productivity, especially using technologically primitive techniques on largely fragmented land in India - has failed to keep in step with explosive population growth.
- This has induced tailwinds for walking inflationary pressures on non-core consumption on non-cereal food crops, which have been largely outside the government mandates of price regulation via its procurement and ration systems, namely the FCI-MSP combine and NSFA, respectively (Swaminathan & Bhavani, 2013).

Poorest of the Poor: Inequity in the distribution of resources in a family unit:

- Coupled with the inability to identify the targeted beneficiaries of poverty alleviation and food security programmes in India's heterogeneous landscapes (Suryanarayana & Silva, 2008), the prevailing sociological factor of inequality in the distribution of nutrition - aggravated in BPL families - causes the formation of the 'poorest of the poor' base constituting under five infants, married women and the elderly.
- Furthermore, larger family units, taking total fertility rates as a factor of income, access to education, and skill levels, are liable to have a greater proportion of food insecurity, as more people are dependent on a smaller pool of resources, thereby increasing its possibility of food insecurity (Mannaf & Uddin, 2012).

Social Stratification and Disparities along Caste and Religious Lines:

- India's nutrition and healthcare programmes are known to reach and ameliorate every social group nearly equally but fail to account for the underlying social causes among the nation's disadvantaged groups such as the age of marriage and literacy for women, access to sanitation and safe drinking water, etc which sustain food insecurity among the SEBCs.(Saigal, N. & Shrivastava, S., 2020).
  - SC and ST communities remain worse off in nutrition outcomes than other groups, the NFHS-4 conducted in 2015-16 found, as had NFHS-2 (1998-99) and NFHS-3 (2005-06). SC and ST children show stunting and underweight levels and ST children wasting levels higher than children of all groups taken together, according to NFHS-4. More SC and ST women are anaemic than women of all groups.
  - SC and ST children show stunting levels of 42.8% and 43.8%, respectively, while all groups taken together to record a lower 38.4%, according to NFHS-4. Similarly, a greater proportion of SC (39.1%) and ST (45.3%) children are underweight compared to all groups (35.8%). SC children show levels of wasting (21.2%) just above all groups at 21%; ST children show 27.4%.
  - For maternal nutrition outcomes such as anaemia among women, SC and ST groups show much higher levels at 55.9% and 59.9%, respectively, compared to all groups at 53.1%.

Literacy and food security:

- There exists a direct correlation between literary and food security, in that children with higher levels of literacy and families with food awareness are likely to enjoy high levels of food security, with a particular focus on female education, as the pursuit of education leads to a statistically significant improvement in reducing child marriage, total fertility and under five undernourishment (UN World Food Programme, 2006)

Therefore, malnourishment and food insecurity is challenged by a mixture of factors like low income, gender discrimination, social standing, occupation, educational levels, etc which influence the availability and affordability of nourishment and also inform the government's ability to correct the prevailing situation via the nationally sanctioned food security programmes.
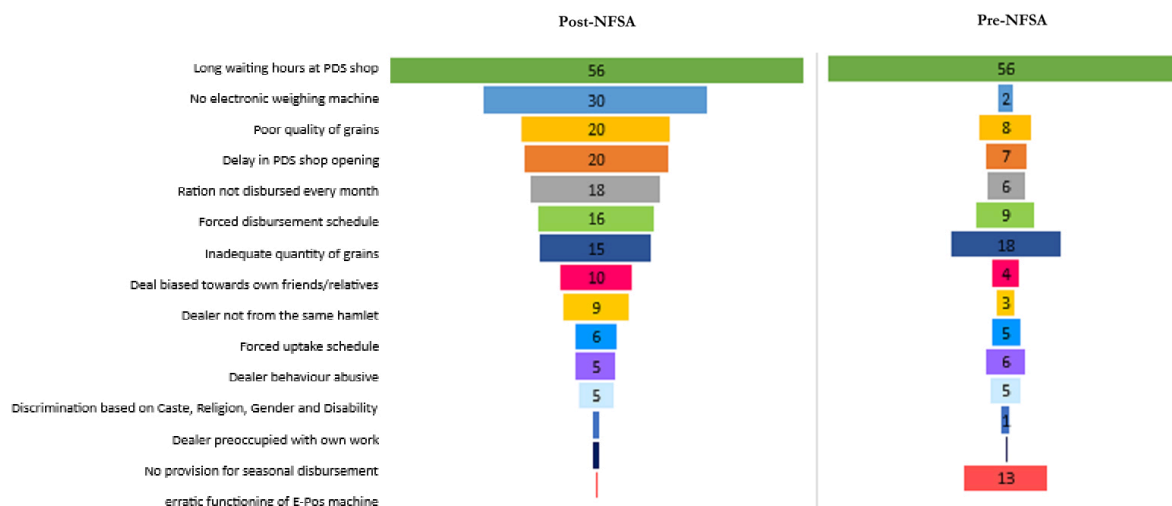
Figure 2: Problems faced by ration cardholders pre- and post-NFSA (%) (Ideas for India, Boss-Pradhan et. al, 16 August 2021)

Policy Suggestions for Food Policies in India:

Following are a few suggestions to ameliorate the NSFA and its subsystems of PDS, Midday Meal Initiative and Integrated Child Development Schemes:

A) Strengthening the PDS system through cross-departmental coordination between the nodal ministries in charge of statistics, food dispersal and others to facilitate precise identification of beneficiaries, particularly in the remote and backward hinterland for the agricultural underemployed and tier 2 & 3 cities for the urban underclass.

B) Utilising the Direct Benefit Transfer (DBT) system, along the line of a quasi-universal food system, by linking bank accounts and biometric data to ration cards as a means of automation to reduce administrative burden; maximising incentives to the poorest of the poor by integrating free cash transfers in their name instead of that of the head of the household into the NSFA in order to increase their fiscal independence (Subramanian, A., & Felman, 2019).

C) Expanding FCI procurement basket beyond the cereal food crops of paddy and wheat, such as pulses and edible oils, along the governmental vertical of ration dispersal to improve dietary considerations in terms of quality of nourishment to mitigate the incidence of non-communicable illnesses in infants,

while simultaneously promoting agricultural sustainability in prosperous states.

D) Boosting and emphasising the Anganwadi system through its timely mobilisation of semi-skilled employed government workers and consumer cooperatives to act as nutrition and health awareness centres, and utilising their social affiliations with local groups to increase efficiency in the targeting of federal policies.

E) Focusing on ameliorating warehousing and storage facilities under the governmental agri-marketing and logistical holding - which constitutes nearly 50% of total dealings - to correct the chronic incidence of stockpiles earmarked for Revamped PDS distribution being lost to spoilage and proliferation and adequately provisioning for prospective losses, in order to mitigate against localised emergency losses.

F) Expanding the reach and oversight of NFSA to achieve even greater universalization for India's poor on an ad-hoc basis until the impacts of the pandemic diminish or imports of foodgrains are required, in light of surplus stocks lying with the FCI, in order to grant a minimum safety net for food security for the overwhelming majority of touch-intensive labour force rendered unemployed.

G) Collaborating with private intermediaries and corporate agents on a private-public partnership to provide last-mile transportation solutions in the

delivery of food grain in metropolitan and high-population density areas via auctioned tenders to reduce costs under the food subsidy bill and allow for greater efficiency and timeliness in the conduct of essential work, thereby injecting competitiveness in the operation of time utility.

H) Addressing corruption and black marketing concerns persisting in the rationing system by minimizing bureaucratic hindrances, legislating to eliminate favouritism prevalent in grain distribution and reducing the human factor present through technological innovations to allow for fixed door-to-door delivery, while instituting a nodal grievance redressal mechanism to investigate allegations and instances.

I) Revising dietary constituents of the PM-POSHAN, formerly known as the Mid-Day Meal scheme, to emphasise a greater share of protein and mineral uptake in school-age children, expanding the daily entitlements of calories in pre-primary and primary education to tackle malnourishment for children during their early years and streamlining the allotment of micronutrients and medicines, currently under NRLM, into a cohesive singular policy to increase their uptake.

J) Generating caste, tribe and religious groups' specific nutritional and healthcare data in both Census and the National Family Health Surveys as a means of gauging a community's progress in food security, empowering the government with targeted data to provide accurate reports, and address lagging social identities, as well as bring previously uncovered communities in remote sectors under the ambit of NFSA.

K) Incorporating literary objectives into the grander fold of objectives under the aegis of social alleviation programmes through the intertwining of public education and food supply beyond the Mid Day Meal to incentivise parents to provide basic minimum education to their children and break the cycle of hunger and poverty, especially for the girl child.

Conclusion

The NFSA has proven to be beneficial in its implementation but is still subject to criticism due to its inadequacies. Through the means of this assessment, corrections may be made with the coordination of all necessary stakeholders associated with the Act - in particular the Union and State Governments and its designated agencies - and in coordinating with last-mile agents to ensure that food grains are timely and effectively delivered to their targeted recipients.

Greater attention has to be paid to the disenfranchised constituents of Indian society, which comprise the primary beneficiaries of government welfare schemes, in order to ensure that food security policies are sufficient and efficient in their execution and delivery of resources to the poorest of the poor, given the strong economic rhetoric which mandates investment in nutrition and healthcare as a sine non qua for correcting income disparities and convergence with advanced economies.

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Blockchain's Impact on Climate: An Analysis of Cryptocurrency's Carbon Emissions and Blockchain's Utility in Combating Climate Change

Hargun Kaur

Abstract

Identical to the rise of the internet in the early 2000s, blockchain and cryptocurrency are the latest evolutions in technology undergoing a breakthrough. However, it is emerging when the world is simultaneously battling through important commitments. Our aim, as outlined in the Paris Agreement, is to achieve the crucial goal of limiting global warming to less than 2 °C. Therefore, everyone is interested in finding out if blockchain will help achieve this aim or end up impeding the progress made so far. This paper explains the functioning of blockchain technology and analyses its features in detailing the carbon footprint of the biggest cryptocurrencies, Bitcoin and Ethereum, which have been investigated, along with the ways it can be reduced. The study further explores the possibilities of blockchain technology to disrupt climate markets through several use-cases. Beyond cryptocurrencies, blockchain is believed to have an enormous potential for replacing the traditional ways of working in many industries and improving their energy efficiency.

Keywords: blockchain, Bitcoin, cryptocurrency, carbon footprint, climate markets

Introduction

In 2008, a whitepaper under the pseudonym of Satoshi Nakamoto was released, which marked the birth of a new technology called blockchain. A new currency called Bitcoin was introduced, which was built on the blockchain network. The goal behind this currency was to break the dependence of digital monetary transactions on a third party and allow the two parties involved to transact directly with each other. This would remove the necessity of a trust factor, which is otherwise the only basis on which payments are made online, and make the process entirely based on cryptographic proof. This is possible through certain features that blockchain technology possesses:

- Decentralised mode of transaction: One of its most progressive features, it essentially means that no single organisation, group or individual holds the power of blockchain in its hands and can be generated by anyone who has sufficient mining resources and hashing power.
- Immutable ledger: Immutability does not allow the data on a blockchain to be changed, which ensures that records stored in the blocks are not tampered .

It is nearly impossible to do so, and if someone does attempt it, the blockchain will be rendered invalid.

- Distributed peer-to-peer (P2P) network: Every person with a computer (called a node) can download the entire blockchain on their system. This means that a full ledger of computational actions is copied across the entire network. If anyone attempts to change a block, it would have to change it across millions of devices. Hence, there is no way to break into the blockchain.

- Mining: This is a process of creating new coins (or blocks) that are added to the chain, using a device's hashing power. The aim is to find the correct hash, also known as the golden nonce. A hash is a hexadecimal number, and in order to arrive at it, a computer has to perform specialized calculations. As more and more Bitcoins are being mined, the difficulty level of mining also increases over time. This means that you would need greater computer power to mine a block. Mining technology has thus evolved over time.[2]

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1 The only possible way is if there is a 51% attack, i.e., if 51% or more miners agree to change the data. This is again an almost impossible situation given the scale of the blockchain network.

2. Application specific integrated circuits. An ASIC miner is a device that uses microprocessors for the sole purpose of mining digital currency.

market. People too have found many innovative ways to mine cryptocurrency, like creating mining pools and setting up large industry-level mining units.

- Consensus Protocol: This helps nodes verify transactions. It gives the nodes the power to decide upon the chain's working. There are different types of consensus protocols, each with its own method of working.

The main climate debate about blockchain technology begins with consensus protocols. As cryptocurrencies have grown over the years, people have argued that they can become significant global pollutants, further hampering our goal of preventing global temperature from rising. Numerous studies have been conducted that support this claim, but at the same time, there is another side to this debate with equally valid arguments. To understand the full situation, it is essential to look at things from the bigger picture and also, keep in mind that this technology is in a constant evolution process.

Literature Review

Opinions about blockchain technology being a hazard to the climate differ widely across academic and industrial communities. It more or less depends upon how it is perceived within these communities.

One-half view blockchain as a dubious technology that is just another form of gambling, a platform for money laundering used for illegal purposes like drug trading and terror financing. Cryptocurrencies, in particular, are blamed for their unregulated and limitless use of power and electricity and are deemed a serious contributor to greenhouse gas (GHG) emissions. This half thus believes it is a useless technology that is a threat to the climate. The values of power consumption by Bitcoin in terms of electricity, the resources used for this electricity production and the carbon emissions generated vary considerably across studies. Lindwall (2022) questions the necessity of cryptocurrency and emphasizes diverting the energy used by crypto assets for other essential needs such as powering homes or food transportation. His study states that about 60% of Bitcoin mining is powered by fossil fuels. Stoll etal., Joule 3 (2019), estimate the annual power consumption of Bitcoin to be 45.8 TWh for 2018 and

global carbon emissions ranging between 22.0 and 22.9 MtCO2. Goodkind et al. (2020) quote the carbon emissions for the four largest cryptocurrencies combined (Bitcoin, Ethereum, Litecoin and Monero) to be somewhere between 3-15 MtCO2. They also find that these four currencies consume more energy than the mining of traditional metals such as gold, copper and platinum in terms of equivalent market value. Besides, electricity consumption has been rising for Bitcoin while the number of Bitcoins mined per year is decreasing (because of the increasing difficulty of hashing). The numbers here are that in 2016, 1 million BTC coins were mined, which required 2.5 billion kWh of electricity, while in 2018, the number of coins mined fell to 700,000 while the electricity consumption increased to 47.9 billion kWh. Mora et al. (2018) evaluated the cumulative emission growth of Bitcoin and claimed that Bitcoin alone is likely to warm the planet by 2°C within 22 years, or as soon as 11 years if it follows the rate of adoption of other broadly accepted technologies.

However, several studies disputed this conclusion. Kamiya (2019), reveals that there are serious issues with Mora's methodology and assumptions for Bitcoin adoption rates and the assumed efficiency of mining hardware. The country and world averages of carbon emissions from Bitcoin are inflated values of the GHG estimates. This is because Bitcoin mining is mostly concentrated in renewable-energy-rich areas. It states that Bitcoin is powered by 74% renewable electricity, which again contradicts the earlier study cited by Lindwall (2022). Carter (2021), delves deeper into the common misconceptions centred around the Bitcoin energy debate. He asserts the difficulty of calculating carbon emission values and how the existing estimates are based on outdated and inaccurate data. He also declares that the method of calculation of energy costs is inappropriate, and the assumption that it will increase in the future is misguided. This calculation, done by dividing total energy by the total number of transactions, is faulty because most of the energy used by Bitcoin is during the mining process, not to support transactions. With progress in mining technology and, in fact, even shifts to already existing, energy-efficient technologies, Bitcoin's energy consumption is likely to reduce in the future, but it only depends on the collective decisions of the mining community.

Overall, it has been observed that the findings that emphasise blockchain being a serious threat to the climate are restricted to observations based just on Bitcoin and its Proof-of-Work protocol. Other cryptocurrencies have been understudied, and their impact is yet to be understood and estimated. Along with this, studies undermining Bitcoin also ignore other use cases of blockchain technology, which are widely gaining traction as massive energy disruptors. These claims are also supported by big, trusted organizations like the United Nations itself, which claims that blockchain technology has huge future potential that aligns with its climate goals. The World Economic Forum also supports blockchain's potential in the energy markets and cites the various ways it can make technology in the agricultural sector more accessible.

Methodology

This paper utilises secondary data sources to analyse carbon emissions and electricity consumption of Bitcoin. Furthermore, regression analysis has been conducted to find the relationship between the electricity consumption of Bitcoin and its monthly prices. Another regression model has been developed using two independent variables and one dependent variable. This model analyses the dependence of Ethereum's daily carbon emissions on its prices and daily energy consumption. The relationship between the aforementioned variables was determined using simple and multiple regression models, respectively, via the Ordinary Least Square (OLS) estimation technique in the Python programming language. The datasets have been used from the Cambridge Bitcoin Electricity Consumption Index and Yahoo! Finance.

Cryptocurrency's Carbon Footprint

- ### Evaluating Proof-of-Work

The carbon footprint of the blockchain industry comes mainly from cryptocurrencies that use the proof-of-work consensus protocol. Out of these, the world's largest cryptocurrency, Bitcoin, is notoriouslyhigh in its consumption of electricity. This ultimately results in it being a substantial contributor to carbon dioxide emissions as well as other global greenhouse gases (CHG emissions), as the electricity

used to power its manufacturing is largely derived from non-renewable resources like coal and oil. In just five years, that is, between 2016 and 2021, there was an approximate 1000% increase in the annual carbon emissions of BTC from coal, oil and gas.
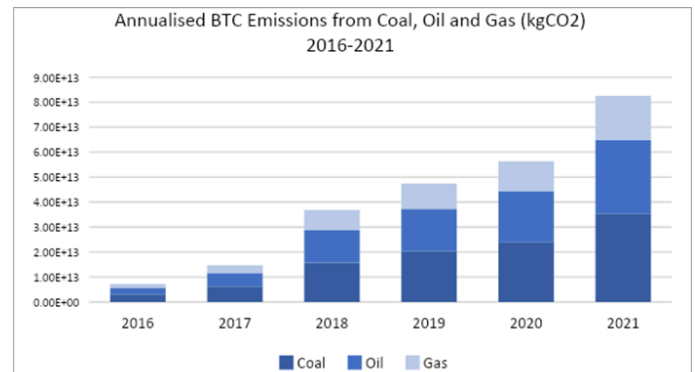

Figure 1: emissions from BTC have been steadily increasing, a large percentage of which is contributed by the world's most polluting resource, coal. Majority of these emissions come from mining Bitcoin, as transactions require a fairly negligible amount of energy.

So why does the Proof-of-Work consume such a large amount of electricity?

The protocol requires all the nodes mining the currency to solve a cryptographic puzzle that returns a hash value. The node that finds it first gets a reward. The catch here is that a lot of computational power is required for this process, for which a mining device should be running on power the entire time, thus requiring a lot of electricity. In 2021, 89,304 kWh of energy was required to produce a single Bitcoin. However, this value is still misleading, as it considers the best available technology that could be used for this process. In reality, the majority of miners would be using comparatively inefficient technology. In this case, the average of all available technologies is almost double the former value, i.e., approximately 142,498 kWh of energy is required to mine one Bitcoin. This estimate is expected to increase in the future with the difficulty of the puzzle increasing and the number of remaining Bitcoins decreasing. Even now, Bitcoin's share of the world's electricity consumption is 0.63%. In fact, this share exceeds the consumption share of many prominent countries of the world.[3] Between 2016 and 2021, there was a massive spike in BTC's consumption of electricity. However, even within the recorded data, there are huge variations because it is difficult to

[3]

---

[3] *Bitcoin's consumption is close to the annual electricity consumption of Egypt (approx. 149,100 kWh) and Poland (149,500 kWh)*

evaluate the exact values of electricity consumption. As there is no formal industry for cryptocurrency mining, it is hard to find out exactly what computational power is being used for. Moreover, all regions of the world do not collect full data on consumption. Consequently, this leads to a large difference between the estimated upper and lower bound values, as shown in the figure below.
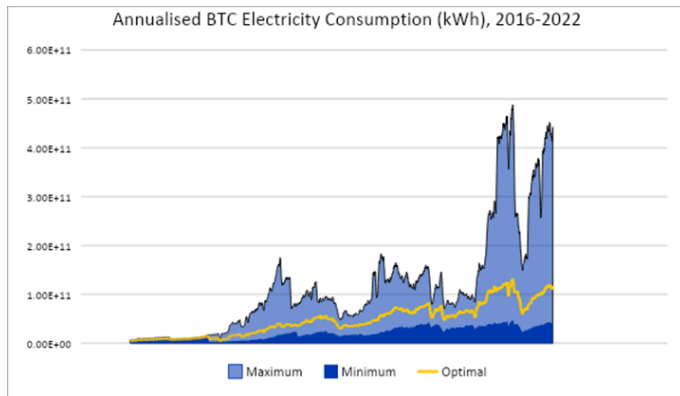

Figure 2: The big difference between the lower and upper bound values of the annual electricity consumption is because of unclarity of data. It is hard to evaluate the exact amount of electricity consumed because it will vary across regions on the basis of demography, technology, etc.

- **Regression Result (BTC)**

In order to build an in-depth understanding of how over the years Bitcoin's electricity consumption has risen dramatically, a simple linear regression model has been developed using the Ordinary Least Square Method. Bitcoin's monthly electricity consumption is chosen as the dependent variable and its price as the independent variable.

In order to build an in-depth understanding of how over the years Bitcoin's electricity consumption has risen dramatically, a simple linear regression model has been developed using the Ordinary Least Square Method. Bitcoin's monthly electricity consumption is chosen as the dependent variable and its price as the independent variable.

$$Y = \beta_1 + \beta_2 X_2 + u_i$$

where

- Y: Monthly electricity consumption of Bitcoin (TWh)
- β_1: Intercept
- X_2: Monthly BTC price (w.r.t. US dollars)
- β_2: Coefficient of X_2

The scatter plot given below shows that the relationship between the dependent and the independent variables (both taken as log values) is positive:
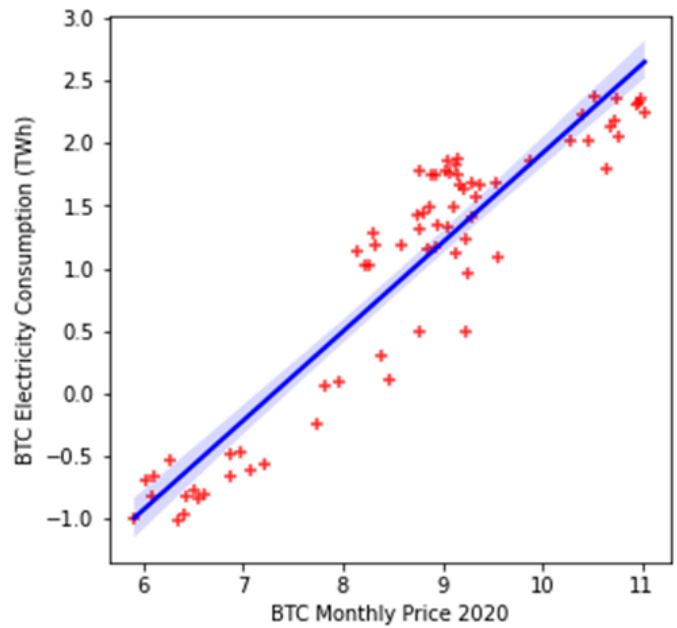

Figure 3: Scatter plot showing the relationship between the Electricity Consumption of Bitcoin in Terawatt-hour and the prices of Bitcoin in US dollars.

The sample regression equation takes the form of:

$\hat{Y} = b_1 + b_2 X$, where b_1 and b_2 are the estimators of β_1 and, β_2 respectively.

Apriori Expectations:

The hypothesis generated is that as Bitcoin's price increases over time, its electricity consumption also increases.

$$H_0: \ b_2 = 0$$

$$H_a: b_2 > 0$$

```
                    OLS Regression Results
===============================================================================
Dep. Variable:                    y    R-squared:                      0.875
Model:                          OLS    Adj. R-squared:                 0.874
Method:               Least Squares    F-statistic:                    492.2
Date:              Tue, 26 Apr 2022    Prob (F-statistic):          2.17e-33
Time:                      19:22:20    Log-Likelihood:               -32.093
No. Observations:                72    AIC:                            68.19
Df Residuals:                    70    BIC:                            72.74
Df Model:                         1
Covariance Type:          nonrobust
===============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
-------------------------------------------------------------------------------
const         -5.2083      0.283    -18.427      0.000      -5.772      -4.645
x1             0.7130      0.032     22.186      0.000       0.649       0.777
===============================================================================
Omnibus:                      7.215    Durbin-Watson:                  0.256
Prob(Omnibus):                0.027    Jarque-Bera (JB):               2.705
Skew:                        -0.002    Prob(JB):                       0.259
Kurtosis:                     2.050    Cond. No.                        55.7
===============================================================================
```

Figure 4: Simple linear regression results

On running the regression, the estimated coefficients are:

$$b_1 = -5.2083$$

$$b_2 = 0.7130$$

The model is also tested for residual errors using the normality of residuals, Q-Q ɪ

The model is also tested for residual errors using the normality of residuals, Q-Q plots (Appendix A), Durbin-Watson and Omnibus tests:

Omnibus: This measures the probability of residuals being normally distributed. The estimated value in this case is 0.027, implying an almost-high degree of normal distribution. This can also be seen in the Q-Q plot and the normality of the residual plot.

Durbin Watson: The model's value is 0.256, implying an even distribution of errors throughout the data. This means that the data is homoscedastic.

Overall, the regression model is statistically significant (R-squared = 0.875). The explanatory variable X significantly predicted the response variable:

1. Goodness of Fit: The R-squared value turned out to be 87.5%, implying that the independent variables can explain 87.5% of the variability in the response variable. This is further backed up by the ANOVA table (refer to the Appendix).
2. The values of b1 and b2 show that as the value of the independent variable increases, the value of the dependent variable also increases.
3. b1 is the intercept coefficient. It represents the average electricity consumption of bitcoin if the price of bitcoin is zero, that is, if X in the given equation is 0.
4. b is the partial slope coefficient. It is positive, which indicates that as Bitcoin's price increases, its electricity consumption also increases by 0.7130.

Even though Bitcoin is the biggest cryptocurrency and the largest segment of blockchain technology, it is still just one part of the picture. There are other currencies like Bitcoin that use the proof-of-work protocol, like Litecoin, Cardano and Monero. Even though they are very small in comparison to Bitcoin, the data on their consumption and emission patterns is insufficient and inadequate. This makes it hard to assess the overall consumption pattern of the proof-of-work cryptocurrencies. However, there are other technologies in existence that are proven to be a lot more energy efficient and perhaps an alternative to this protocol.

- **Proof-of-Stake as an alternative protocol**

A very well-known consensus protocol, the proof-of-stake was first introduced with a cryptocurrency called Peercoin. It is based on the principles of game theory and is very different from the proof-of-work system. Essentially, all the nodes do not participate in the mining process. There are two parties involved- the validators and the nominators. The validators commit a stake to the blockchain in return for which they earn a reward if they are chosen by the nominators to mine a block. The nominators themselves do not participate in the mining process simply because of the lack of availability of the adequate technology required to do the mining. Instead, the nominators delegate a stake to the validators they trust. The decision to choose the right validator is based on a game theory analysis.

In this scenario, both the validators and nominators are rational decision-makers attempting to maximise their utilities under a set of rules and strategies. The validators' strategies would be deciding how much to stake, whether to run single or multiple nodes, etc. On the other hand, nominators have to decide which cryptocurrencies to stake and which validators to nominate. In order to gain the maximum returns from the stake, the validators and nominators have to choose the optimal strategy. Thus, investors can make tactical choices while allocating their resources. Since all the nodes in the system are not haphazardly involved in the mining process and there is a selection for the miner, Proof-of-Stake consequentially uses a very low amount of energy. In fact, this reduction is so significant that the world's second-largest cryptocurrency, Ethereum, in order to keep up with its climate commitments, is shifting to a PoS protocol in 2022. It claims that such a transition will reduce its energy consumption by approximately 99.5%.

- **Regression Result (ETH)**

A multiple linear regression model was built to analyse the influence of Ethereum's daily prices and energy consumption on its carbon emissions using the Ordinary Least Square method. Here, two independent variables and one dependent variable have been chosen accordingly.

$$Y = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + u_i$$

where,

Y : Daily carbon emissions of Ethereum (ktCo2)

β_1 : Intercept

X_2 : Daily ETH price (w.r.t. US Dollars)

β_2 : Coefficient of X_2

X_3 : Daily energy consumption (GW)

β_3 : Coefficient of X_3

Apriori Expectations:

The hypothesis generated is that as Ethereum's price and energy consumption increase over time, its carbon emissions will also increase.

The sample regression equation takes the form of:

$Y = b_1 + b_2 X_2 + b_3 X_3$, where b_1, b_2 and b_3 are the estimators of β_1, β_2 and β_3 respectively.

H_0 : $b_2 = 0$, $b_3 = 0$

H_a : $b_2 > 0$, $b_3 > 0$

The scatter plot below shows that the relationship between the dependent and the independent variables (taken as log values) is positive:
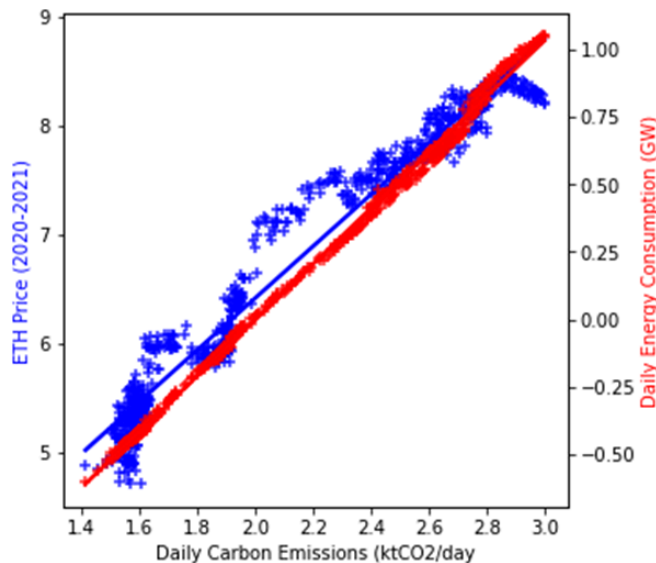

Figure 3: Scatter plot showing the relationship between daily Ethereum carbon emissions, its price and energy consumption

```
                    OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.998
Model:                            OLS   Adj. R-squared:                  0.998
Method:                 Least Squares   F-statistic:                 2.187e+05
Date:                Tue, 26 Apr 2022   Prob (F-statistic):               0.00
Time:                        20:06:24   Log-Likelihood:                 1820.4
No. Observations:                 731   AIC:                            -3635.
Df Residuals:                     728   BIC:                            -3621.
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          1.8638      0.019     97.405      0.000       1.826       1.901
x1             0.0216      0.003      7.266      0.000       0.016       0.027
x2             0.9146      0.007    131.077      0.000       0.901       0.928
==============================================================================
Omnibus:                        6.760   Durbin-Watson:                   0.155
Prob(Omnibus):                  0.034   Jarque-Bera (JB):                6.945
Skew:                           0.183   Prob(JB):                       0.0310
Kurtosis:                       3.306   Cond. No.                         191.
==============================================================================
```

Figure 4: Multiple linear regression results

On running the regression, the estimated coefficients are:

b_1 = 1.8638
b_2 = 0.0216
b_3 = 0.9146

The model is also tested for residual errors using the normality of residuals, Q-Q plots (Appendix A), Durbin-Watson and Omnibus tests:

Omnibus: This measures the probability of residuals being normally distributed. The estimated probability value, in this case, is 0.034, implying an almost-high degree of normal distribution. This can also be seen in the Q-Q plot and the normality of the residual plot.

Durbin Watson: The model's value is 0.155, implying an even distribution of errors throughout the data. This means that the data is homoscedastic.

Overall, the regression model is statistically significant (R-squared = 0.998). The explanatory variables X_2 and X_3 significantly predicted the response variable:

1. Goodness of Fit: The R-squared value turned out to be 99.8%, implying that the independent variables can explain 99.8% of the variability in the response variable.
2. The positive values of b_1, b_2 and b_3 show that as the value of the independent variables increases, the value of the dependent variable also increases.
3. b_1 is the intercept coefficient. It represents the average carbon emissions of Ethereum if the price and energy consumption of Ethereum are both zero, that is, if X and X in the given equation are 0.
4. b_2 is the partial slope coefficient. It is positive, which indicates that as Ethereum's price increases, (other variables being constant), its carbon emissions increase by 0.0216.
5. b_3 is the partial slope coefficient. It is positive, which indicates that as Ethereum's energy consumption increases, (other variables being constant), its carbon emissions increase by 0.9146.

- **Comparing the two protocols**

We are now faced with an important question- if the PoS is so energy efficient, why doesn't Bitcoin shift to this consensus? There are many things to consider.

Firstly, there have been doubts about the staking

process. Miners are chosen according to their share of the stake; the larger the stake, the higher their chances of being chosen to mine the next block. This defeats the entire purpose of blockchain networks being decentralised, as there are chances of validators acquiring large stakes and thus getting chosen repeatedly. Secondly, as this operation has not yet been conducted on a large scale, there is no guarantee that it can safely replace the proof-of-work system.

Moreover, there is also some evidence for the PoW actually being an efficient system. A 2019 report suggests that 73% of Bitcoin's energy consumption is carbon neutral. This claim is not hard to foresee. Since any mining unit would aim to maximise its profits, it would aim to mine cryptocurrency at the cheapest cost. Many mining units can thus be seen in areas where energy is not just the cheapest but also produced from renewable sources. One main example is China's southwest region, which has abundant hydroelectric power and is also home to large Bitcoin mining units. Additionally, it is also true that a staggering amount of electricity produced in the world goes to waste every year, especially in areas where production outpaces demand. A study estimates that 66% of the primary energy used to create electricity is wasted by the time the electricity reaches the end customer. This energy can thus be used for mining blockchain.

Defenders also assert that with time, as renewable energy options outperform traditional sources, miners would actually have the incentive to build and further improve them.

Even so, blockchain technology is still in its initial stages and will undergo a massive evolution, and so would the consensus protocols associated with it. It is too soon to decide whether something will work or not, especially before implementing it on at least some relevant scale. In the end, the decision as to which protocol is the best lies with the mining community itself, and thus, they themselves are responsible for the system they choose to adopt. It is safe to say that they will represent the interests of a much larger community, or in fact, the entire population itself, as the network already consists of millions of users.

Blockchain's Utility in Combating Climate Change

• Blockchain beyond Bitcoin

When entering the blockchain climate debate, it is inaccurate to consider just one side of the story. The use of blockchain as a cryptocurrency is only one of its many aspects. In reality, blockchain has the potential to disrupt many major sectors of the world, particularly the global supply chain in the energy sector. It is deemed to be the future of climate markets, where a great number of unrealized possibilities can be explored

• Tapping Climate Markets

Climate markets, also commonly known as carbon markets, are marketplaces where the buying and selling of carbon emissions take place. Essentially, industries have a cap on the amount of GHG emissions they can produce. Those who manage to emit less than the cap amount can then sell the difference to firms that are not able to reach that target. This kind of trade can happen between countries as well. A system like this encourages countries to reduce carbon emissions and thus also meet their climate goals. However, some drawbacks exist in the system. Firstly, there is a risk of "double-counting", which means that a country that has produced emissions below the cap value might be tempted to sell the leftover emission rights to another country as well as count it as its own reduction. This would lead to the value being reported twice, leading to the actual CO_2 emissions being double of what is reported in reality. This problem is similar to that of double-spending in the blockchain world. Furthermore, there have been reported incidents of exploitation of these carbon markets due to fraud and tax evasion. Due to this, the end recipient of the entire process, which is usually an indigenous or small local community, is vulnerable.

Blockchain technology can tackle this by creating a system of accountability that would require data verification at each step of the supply chain. It will be constantly recorded, updated and monitored.

• Carbon Offsetting

Another difficulty in the cap-and-tap climate market is that the capping happens below the levels that are necessary to meet our climate goals, creating a carbon offset. Carbon costs are thus set below the real social costs of carbon. This occurs because if the carbon prices are raised, there will be excess supply in the market. To deal with this, blockchain technology can be used in innovative ways. For example, a platform can be created where carbon offsets are exchanged for tokens on blockchain networks. In this way, firms will also have an incentive to reduce carbon emissions, as they will earn tokens as rewards.

A similar approach is being used in renewable energy markets. An example of this is SolarCoin, which incentivizes producers' solar energy by rewarding them with one free SolarCoin for every MWh of electricity they produce. This token can be converted to any currency of their choice.

• Exploring Smart Contracts

Smart contracts are like "agreements" with certain terms and conditions embedded in a code. They can be executed when those terms are met. This is a ground-breaking idea as it removes the dependency on an intermediary to validate a contract and allows the two parties involved to deal directly with each other. They will jointly establish the terms and conditions, and since tampering with a blockchain is extremely hard, there is no room for fraud. If settlements and record-keeping that usually happen on paper (or digitally), like wills, property documents and legal/administrative paperwork, are shifted to smart contracts, there will be a massive reduction in costs, a large amount of time will be saved that would otherwise be used in approval and sanctioning, and millions of trees will be saved from being cut down.

Conclusion

Global warming is not an event of the distant future but rather an ongoing process. We are racing against time to live up to our commitments and are in desperate need of technology that can help boost this process. While there is an urgent need to make Bitcoin and similar currencies energy efficient, closing

the debate without exploring the full potential of the technology behind it would be limiting our perspective and consequently the numerous possibilities that come with it. Blockchain explores new ways in which we can address global climate problems through tax mechanisms and incentive schemes and encourages parties to adopt energy-efficient measures and contribute their bit. Even though implementation at a large scale is yet to be seen, there is no doubt that blockchain can pave our way to becoming a greener planet and encourage the adoption of renewable energy sources.

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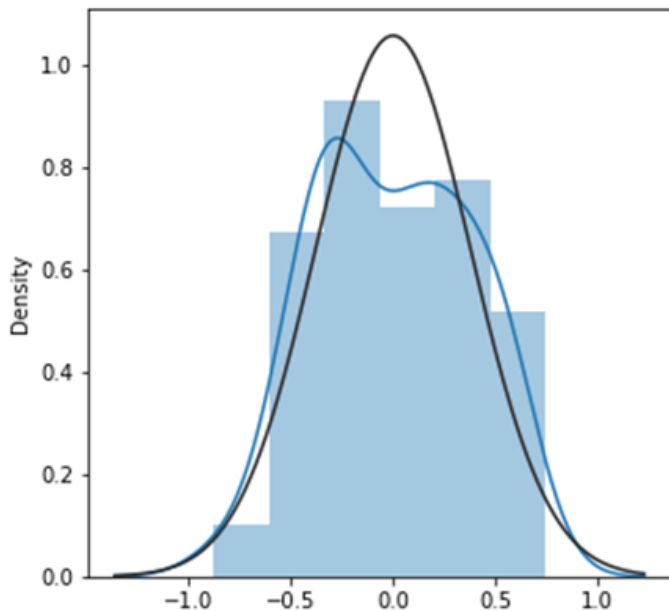
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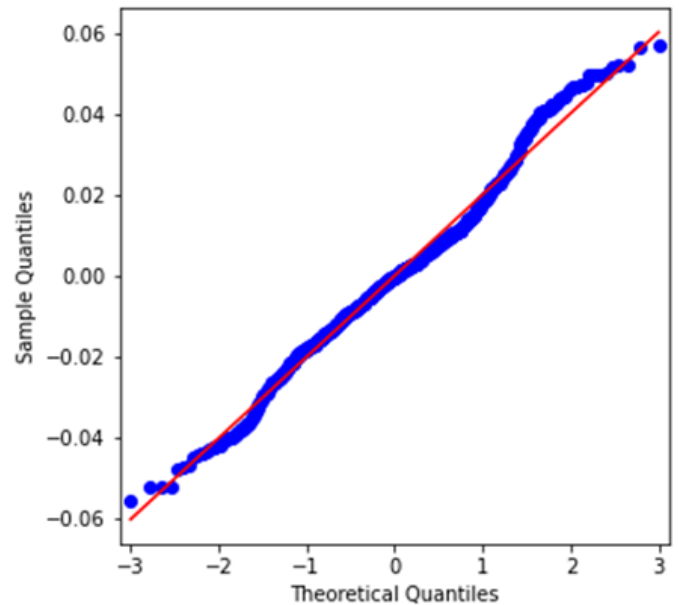
Appendix

Bitcoin's Tests for Normality
1. Normality of Residuals
2. Q-Q Plot:

3. ANOVA Table

	df	sum_sq	mean_sq	F	PR(>F)
X	3.0	176.664485	58.888162	145817.463017	0.0
Residual	728.0	0.294002	0.000404	NaN	NaN

I2U2: A Meticulous Step in the Direction Of India's "Strategic Autonomy"

Om Marwaha, Amit Naganyal, Dev Ishaan Agarwal

Abstract

Every country has always strived to become independent as well as establish a relationship of interdependence in the global arena. Even when a country reaches the pinnacle of development, it still needs to rely on other countries in some capacity in order to advance its own interests. In the modern world, developing foreign policies is a crucial responsibility of a state. This involves establishing diplomatic, economic, trade, educational, cultural, and political connections with other nations. It requires maintaining relationships with not only other states but also non-governmental organizations and other participants in the global sphere. Foreign policies are like a charter containing national interests, outlining the areas of agreement and disagreement in international politics since sovereign states conduct their foreign relations and communicate with one another through them.

Following the above paragraph as the Preamble of this paper, this study will deal with the understanding of certain crucial concepts like Multilateralism and the idea of Collective Security, which will include India's perspective on the significance of these terms. This will be followed by a critical appreciation of the works of renowned political and economic scholars on foreign policy strategies, highlighting India's active role and standing as a developing nation on the global stage through participation in important international agreements like UNO, QUAD, SCO, and SAARC. The study will move forward to examine the significance of I2U2, a newly established alliance among India, Israel, the USA, and the UAE. The analysis will involve comparing various economic and social parameters between these organizations.

Further, the study will discuss and analyze the significance of I2U2 in relation to India's new foreign policy of Strategic Autonomy, adopted four years ago, shedding off the imprints of the Non-Alignment Policy which was quite visible in the earlier participation in regional and international groupings. Finally, the paper ends with a positive message and a ray of hope that with the help of I2U2, India optimizes its foothold even deeper and stronger to fulfil its vision of a developed nation by 2047, at the completion of the hundred years of its Independence.

KEYWORDS: Foreign Policy, Multilateralism, Collective Security, International Agreements, I2U2, Comparative Statics, Strategic Autonomy, Developed Nation

Introduction

International relations in the post World War II era completely diverged from those prevalent in the pre-war era. The latter was a Euro-centric system that was founded on the ideas of power balance, war as a tactic, covert diplomacy as a tool, and limited nationalism as the ultimate goal. A new international order eventually took its place. The United States and the Soviet Union became superpowers as a result of the war, which also saw the defeat of the Axis nations, the creation of the United Nations, the cold war, bipolarity, nuclear weapons, non-alignment, anti-imperialism, the UN, and the active participation of several newly independent states.

In the post-World War II era, the United States decided to fill the power vacuum in Europe with its superior economic and military position. To this goal, it decided to woo the democratic European nations with the Marshall Plan. Additionally, it decided to oppose the growth of communism.
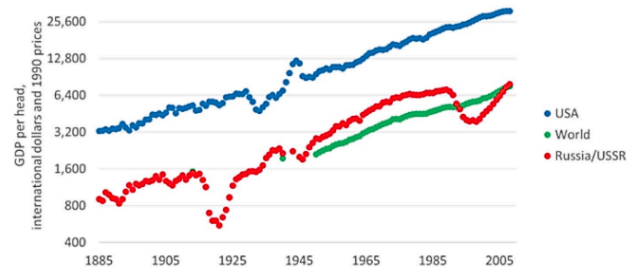
The main objective of US foreign policy became the "containment of Communism." The USSR vehemently resisted such an American initiative and also decided to increase its influence in Europe. It became more confident as a result of its success in introducing socialism to the nations of Eastern Europe. The United States introduced several bilateral and multilateral security alliances, including NATO, SEATO, ANZUS, and others, to unite the democratic, anti-communist nations under US direction. By forming the Warsaw Pact, the USSR retaliated against the move by the communist nations. Two antagonistic factions or blocs, the US Bloc and the Soviet Bloc, emerged as a result of these events. The guiding principle of all these blocs was that an attack or threat on one nation would be regarded as an attack or threat on all the nations involved in the bloc and this paved the idea of Collective Security, which became one of the most important principles for any international agreement to come into force. But America was coming up as the main superpower in the world with its abundant natural resources, military superiority and diplomatic influence.

The Organization of the Petroleum Exporting Countries was one of the organizations established to challenge American dominance. OPEC, a club of nations that was established in 1960, is responsible for a sizable amount of the world's oil supply and uses its collective negotiating strength to control oil prices. By successfully using its oil resources to establish its influence on the international arena, this group has been crucial in limiting the economic dominance of the United States. The European Union (EU) was established to promote economic integration and political cooperation among its member countries, providing a counterbalance to US dominance in Europe. This international order persisted until the final decade of the 20th century till the USSR's collapse and the conclusion of the Cold War which made the USA the lone superpower. After the end of the cold war, the Shanghai Cooperation Organization (SCO) was established in 2001 to promote economic and security cooperation among its member countries in Asia. With the onset of certain international agreements like ASEAN, and SAARC, the USA began to lose its hegemony and this led to the strengthening of the idea of
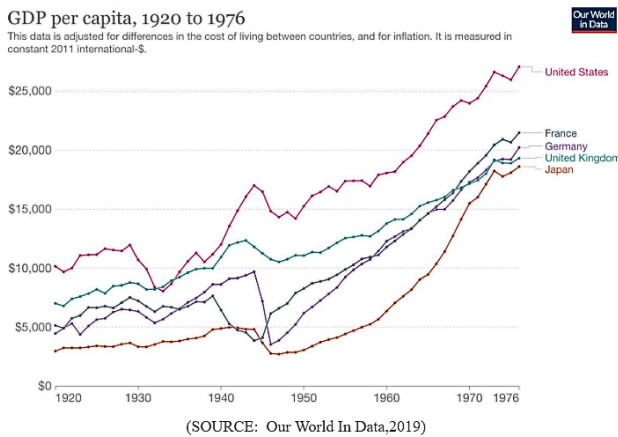
multilateralism, which India strongly propagated and used this as a crucial weapon to emerge as a leader and the face for the developing world by promoting peace, equality, and economic development, and in providing a platform for countries, especially theAsian and African domain to counterbalance such superpowers and formulate a cooperative world where all the countries can work together for the attainment of one common goal-The Universal Brotherhood.

Literature Review

Geir Lundestad(1991) connects political, economic, and security-related issues while highlighting the significance of regional politics in determining the scope of US power. Although, in his opinion, US influence has decreased relative to other countries since 1950, it is still the world's most powerful state. However, using the word "empire" to describe American hegemony hinders Lundestad's careful and nuanced analysis because it obscures rather than clarifies the differences between American and other Great Powers' forms of rule, such as Great Britain in the nineteenth century or the Soviet Union in the twentieth. In addition to this, Nye(1990) successfully demonstrates that the United States is still the most powerful nation on the planet, that the comparison between modern-day America and 19th-century Britain is flawed, that Japan is not about to take over as the world's superpower, and that in terms of geopolitics, the USA has even risen to the top. The United States has not, however, reversed its relative long-term economic loss, and so it does not disprove Paul Kennedy's (1987) claim that military prowess and political power would be greatly impacted if current economic patterns persisted. Lundestad(1991) and Nye(1990) had been advocates of the bitter truth of the prevailing USA Multilateralism around the

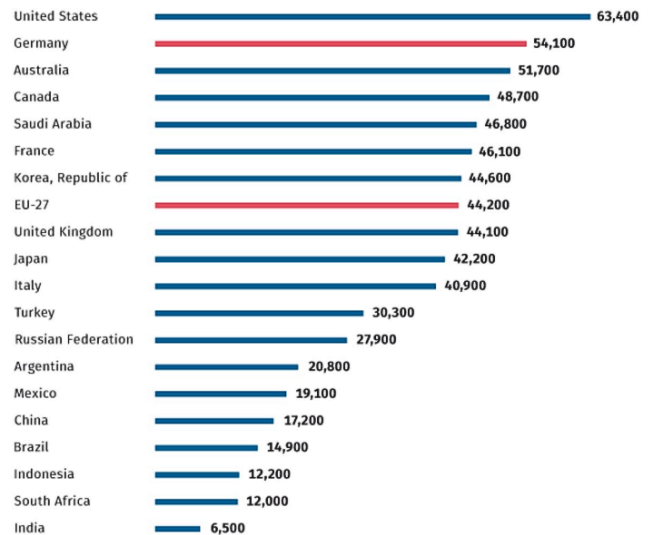(SOURCE: USA and the World from Markevich and Harrison(2011)

GDP per capita, 1920 to 1976
This data is adjusted for differences in the cost of living between countries, and for inflation. It is measured in constant 2011 international-$.

Our World in Data

United States
France
Germany
United Kingdom
Japan

(SOURCE: Our World In Data,2019)

globe, describing the USA as the "ruler of the world's empire", weighing a higher usage of words above hegemony.

But, there has been a declining trend of weakness and loosening of the grip of the ruler of the world empire after the 9/11 attacks and since then, there has been an emergence of the formation of the regional groupings cum organizations which have attained international status in the geopolitical arena according to N.Ahmad(2011) and M.K.Bhadrakumar(2011) like Group of Seven (G7), Group of Twenty (G20), Quadrilateral Strategic Dialogue (QUAD) and Shanghai Cooperation Organization (SCO). Ironically (or surprisingly as one may say), G7 originated in the 1970s-1980s due to the collapse of the Bretton Woods System and the prevailing oil crisis of 1973 but rose to prominence during the decade of 2000s. According to Hanjal and Kirton (1999), the central role of G7 formation is "to create consensus and consciousness among its members at the highest attainable political level on all the major global issues, keeping in mind a member nation's constraints, priorities and goals. Merlini(1999), on the other hand, presses a strong critique on its deliberative role by arguing that G7 has been unable to perform as a decision-making forum in terms of the implementation of its strategies and has been acting like a "dead orchestra".

In the middle of the world financial crisis, the G20 gathered for the first time in 2008 with leaders of state and government coming together. The G20 organized group efforts the next year that assisted in containing the worst consequences of the financial crisis (Berger 2020). A decade later, the G20 is coping

with an underlying systemic crisis that is being fueled by major countries' opposition to rules-based international cooperation as well as critiques of its efficiency and legitimacy. Notwithstanding the G20's crucial role in the early stages of the global financial crisis, concerns have been voiced with regard to a variety of topics related to the G20's nature and potential effects on global governance. The G20 worked on the principles of an informal club summit procedure, in contrast to the established institutional pillars. The composition of the G20, a self-selective body in terms of membership, and the arbitrary nature of its member selection came under heavy examination(Cooper 2020). The effectiveness of the G20 was questioned once the first divisions between the European Union (EU) and the other G20 members, and in particular the United States (US), regarding the response to the Euro crisis began to show. These divisions were in addition to worries regarding legitimacy, most notably concerning a potential rivalry between the G20 and the United Nations (UN) on economic policy issues (Grimm 2020).

G20 countries: Gross domestic product per capita 2020
International US dollars (purchasing power adjusted)

Country	GDP per capita
United States	63,400
Germany	54,100
Australia	51,700
Canada	48,700
Saudi Arabia	46,800
France	46,100
Korea, Republic of	44,600
EU-27	44,200
United Kingdom	44,100
Japan	42,200
Italy	40,900
Turkey	30,300
Russian Federation	27,900
Argentina	20,800
Mexico	19,100
China	17,200
Brazil	14,900
Indonesia	12,200
South Africa	12,000
India	6,500

(SOURCE: International Monetary Fund(IMF) Database,2021)

Also, during the decade of 2000s, the popular term "Indo-Pacific" came into the picture, which refers to an allegedly important and contiguous strategic region that includes the eastern Indian and Western Pacific oceans. The idea of a resurrected alliance—the Quadrilateral Security Dialogue between the United States, Australia, India, and Japan (or "Quad") —

accompanies this concept(Roy Chaudhary 2018). One of these nations differs from the others. Inconsistencies exist between India's marine goals and strategy and those of the other Quad powers. Instead of an Indo-Pacific vision, India has an Indian Ocean vision, mostly political, economic, and rhetorical in the immediate term due to the Indian Ocean's strategic importance and restrictions on its maritime power projection. But, India's excitement for the Quad has apparent limits. India, Japan, and Australia should exercise prudence because they don't want to anger China at a time when the US's commitment to the region's security is in doubt. Notwithstanding that common caution, New Delhi has historically avoided alliance-like international agreements and has had mixed feelings about democratic groups (Kate 2018).

I2U2: A New Scope of Horizon for the Present World Order

I2U2 is a new coalition created by India, Israel, UAE, and the US. Its main objective is to increase commerce, collaboration in the fight against climate change, cooperation in the energy sector, and coordination on other crucial common interests between the Middle East and Asia. The formation of this grouping lies with the signing of the Abraham Accords in September 2020 by Israel, the United Arab Emirates and Bahrain, which were mediated by the United States and resulted in the normalization of ties between Israel and many Arab Gulf nations. Also, the four nations saw the necessity to cooperate to uphold their strategic interests and combat the growing threat of terrorism and extremism as a result of China's and Russia's increasing influence in the area. The Prime Areas of Cooperation of I2U2 are:

Security: In the context of this new group, this will assist the countries in investigating security cooperation among the four countries. India already has a strong bilateral security partnership with the US, Israel, and the United Arab Emirates. The I2U2 alliance has the potential to considerably improve the capabilities of the four nations in terms of information sharing and defence cooperation. In order to combat terrorism and extremism, this might involve cooperating on military exercises and

training, exchanging defence technologies, and sharing intelligence.

Technology: Each of these nations is a centre for technology. In each of these nations, biotechnology is also widely used. Israel is already referred to as a startup nation. Additionally, India has been expanding its own startup environment. UAE also understands that the future of the global economy won't be based only on fossil fuels like oil and gas.

Trade and Connectivity: I2U2 has the potential to revitalise and re-energize the four countries' trade and commerce systems. UAE is India's second-largest export market after the US. Also, I2U2 will support India's initiative to establish a connectivity corridor that spans from India to the Arabian Gulf across the Arabian Peninsula to Israel, Jordan, and eventually the European Union. This project is being supported by the UAE, Saudi Arabia, and the United Arab Emirates. If this corridor is finished, India will be able to considerably reduce shipping costs. (for example, from Mumbai to Greece by over 40%).

Energy Sector: Another important area of collaboration for the I2U2 alliance is the energy industry. The four nations, which are among the biggest producers of oil and natural gas worldwide, may work more closely together in the future to produce and export these resources. Additionally, the cooperation has the potential to encourage investment in renewable energy, notably solar and wind power, which would aid in meeting the difficulties posed by climate change as well as the rising energy demand.

Hence, growing collaboration and a shared dedication to regional peace, stability, and prosperity have characterized India's engagement with the other three nations.

Research Question

After critically appreciating the works of the renowned scholars in the section of Literature Review, there is one major critique of all these works for their limited coverage. All these research papers and articles tended to focus on the USA as a superpower and the critical performance of some of the international agreements like QUAD, G7, and G20 but none of these works have been able to effectively elevate the importance of India's newly formed foreign policy of "Strategic Autonomy". More importantly, these works do not highlight the estimated future of the recently signed international agreement of I2U2, with India forming an alliance with three other countries, namely Israel, the United States of America(USA) and the United Arab Emirates(UAE) to move towards a smooth oriented world order. Thus, keeping these limitations in mind, this study will try to address the importance of these two crucial instances from the perspective of India's foreign policy plus it will address the growing importance of I2U2 as an emerging international grouping in the present times and how the scope, functions and the effectiveness of this organization is way ahead than its so-called "competitors" to achieve the path of Collective Security and become the best example of Multilateralism. To discuss such important topics, this study will be particularly focusing on the three most important research questions entirely related to our topic of study:

1. Whether I2U2 holds much more significance than other international organizations like QUAD and G20 in terms of economic parameters?
2. Will the USA try to retrieve its hegemony in I2U2 as previously seen in other regional and international agreements and move the world order towards the Unilateralism ideology?
3. Will India be benefitted from this newly set-up organization of I2U2 favouring India's "Strategic Autonomy"?

Thus, in order to provide detailed and satisfactory answers to all these research questions, it becomes important to devise a proper research methodology to prove the significance of I2U2 and India's Strategic Autonomy foreign policy in a much more transparent manner with evidence in the form of graphical data and its representations.

Research Methodology

This study will be revolving around the newly created I2U2 and its comparison with its fellow frenemies like QUAD and G20 in terms of crucial economic parameters in the form of defence strategic ties and its relevance and the underlying potential of the green energy sector, which is the USP as well as the benchmark set by the I2U2.

- The defence strategic alliance as a parameter will include relevant graphs to justify the worthiness of I2U2 in comparison to other regional organizations and most importantly, it will provide a guiding help to tackle the challenges posed by the Russian-Ukraine War 2022.

- This will be followed by the next economic parameter in the form of the green energy sector, where there will be a broadly evaluated description of the newly launched initiatives in this sector by the new organizations that have entered in the present world order and how it will drive us towards the fulfilment of the goals of the Sustainable Development Agenda 2030, which is garnering attention in geopolitical talks across each corner of the world.

- Next, the study will deal with a broad discussion of the answers to the research questions using the economic parameters as the base for providing a near wholesome answer to all the above-mentioned questions.

- Under the "Discussions" section, the study will also highlight how India's foreign policy could take a giant leap at the global level through I2U2.

And finally, it will conclude by highlighting the pros and cons of I2U2 from India's perspective as well as taking into account other member countries' issues as well.

The Impact of I2U2 on Difference Strategic Ties for India and the Rest of the World

India had the second-largest army in the world. It ranks third globally in terms of military spending, surpassing both the UK and Russia. India, meanwhile, is heavily reliant on imported weapons systems. India is the world's biggest importer of weapons and equipment. However, recently, the Indian government has placed a higher priority on the indigenous production of defence weaponry; this change in focus is partially connected to the government's 'Atma Nirbhar Bharat' campaign. The Indian government has promoted local development in the field of defence manufacturing to reduce reliance on foreign weaponry. The capital budget for the military has grown over time in order to promote domestic manufacturing firms.
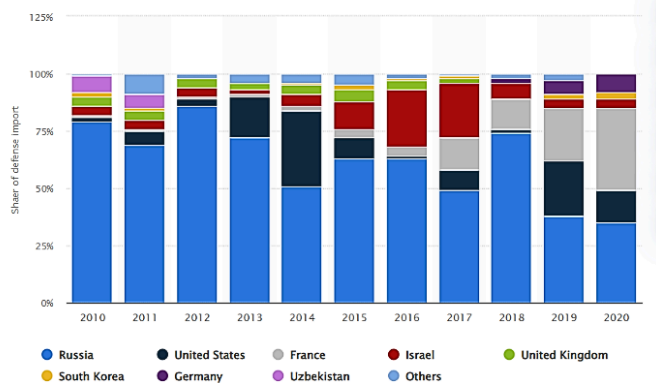
Over the years, the United States and Israel have been among India's top arms suppliers, although trade has been inconsistent. Yet I2U2 offers the chance to re-evaluate the defence trade agreement with two countries, and given that both of them are prolific weapons producers and have top-notch technology, they may serve as committed and reliable providers of weapons for India. Also, the US is eager to forge stronger defence connections with India, and it has taken the first step towards this goal by signing a new defence agreement with India. The National Defence Authorization Act, which was approved by the US Senate, is an $858 billion defence budget that aims to improve defence ties with India. Additionally, it intends to reduce the nation's dependency on Russian-made military systems by supplying billions of dollars to counter China's threats to American national security. In the past, crucial parts and technologies for American military systems have been sourced from Russian manufacturers. However, efforts to lessen this dependence and diversify the supply chain have been motivated by worries about national security and geopolitical dynamics. The goal

is to strengthen the home defence sector and combat future challenges, notably, those coming from China Technology: Each of these nations is a centre for technology. In each of these nations, biotechnology is also widely used. Israel is already referred to as a startup nation. Additionally, India has been expanding its own startup environment. UAE also understands that the future of the global economy won't be based only on fossil fuels like oil and gas.

Regarding Israel, India has always relied heavily on Israeli technology and equipment for border security and anti-terrorism. As a result, India has bought the most Israeli weapons during the past ten years. India's demand for weapons consumes up to a large portion of Israel's defence manufacturing, creating a win-win situation for all parties.

Despite minor impediments, India and Israel have a real opportunity to strengthen their partnership. Also, Israel and the United States are two of the top countries in the defence and research industries. Through I2U2, it is hoped that both nations will cooperate with India, offer guidance, and even launch joint defence projects that will help India acquire cutting-edge technology.

I2U2 as an Epitome in Green Energy Transition

In the area of clean energy, India has some ambitious and heroic goals. It wants to achieve net zero emissions by 2070 and get half its electricity from renewable sources by 2030. India is making a big contribution to the global fight against climate change and is setting the bar for other developing nations by working on a new model of economic development that could minimize the use of carbon-intensive methods. A new goal of 500 GW of non-fossil fuel-based energy by 2030 was set by the nation during COP26. However, addressing short-term energy needs while working towards the stated objectives can be tricky because India's sheer size and rapid population growth means that in the future decades, its energy demand is expected to increase at an exponential rate. Yet, India is not alone in this endeavour; its I2U2 partner UAE also has similar goals for its green energy ambitions, so there is potential for a productive alliance.

Green energy is one of the key elements of the I2U2 partnership. The UAE is in a transition phase; while it currently has an abundance of natural energy resources, it has the world's seventh-largest proven oil and natural gas reserves. Thus, it would want to diversify and increase its power sources. To that end, the UAE is putting forward-thinking initiatives in the fields of renewable energy and energy efficiency. The UAE is looking at new methods of generating the energy required to support its economy. Hence, the initiative to achieve net zero emissions by 2050 has been taken on by the UAE.

During the I2U2 conference, it was announced that the first of several hybrid energy power plants would be constructed in Gujarat. This particular project will consist of 300 MW of wind and solar power, in addition to a battery energy storage system. The project, estimated to cost USD 330 million, was made possible by a feasibility study funded by the US Trade and Development Agency. Companies from the UAE are seeking to participate as significant partners in terms of knowledge and investment opportunities. Indian businesses are also eager to take part in this initiative and help India reach its 2030 target of 500 GW of non-fossil fuel capacity.

Discussions

COMPARATIVE ANALYSIS:

To answer our first research question, the study will take into account the analytical comparison among I2U2, QUAD and G20. The reason for selecting QUAD and G20 for the analysis is primarily due to their extensive impact on global diplomacy. Additionally, the countries involved in these organizations hold significant positions in the current constrained world order. Thus, this section will compare I2U2 with the rest two organizations one by one:

I2U2 AND G20: G20 as a political structure is a much larger organization that includes the world's 20 largest economies. It has a broad mandate to promote international economic cooperation and address global economic challenges. While the I2U2 group is focused on enhancing economic cooperation among its members, it is much smaller in scope and scale than the G20. But, I2U2 has started a partnership for renewable energy intending to boost

the usage of clean energy sources in the area, as well as activities to increase energy efficiency and lessen waste, which is all part of the cooperation, instead of solely boosting economic growth as G20 does in terms of trade and other aspects.G20 lacks the pinpoint focus of sustainable development and renewable energy partnership as compared to I2U2.

Figure 3a: **Global GDP and trade growth**
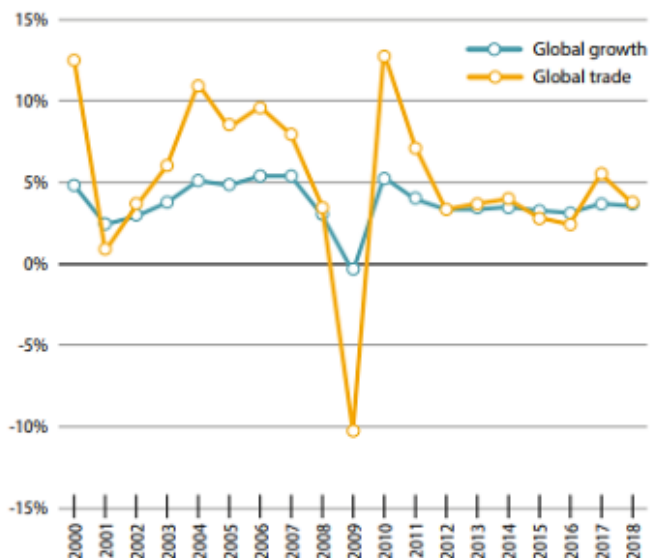
Source: OECD Economic Outlook Database

Figure 3b: **FDI flows from the G20 economies**
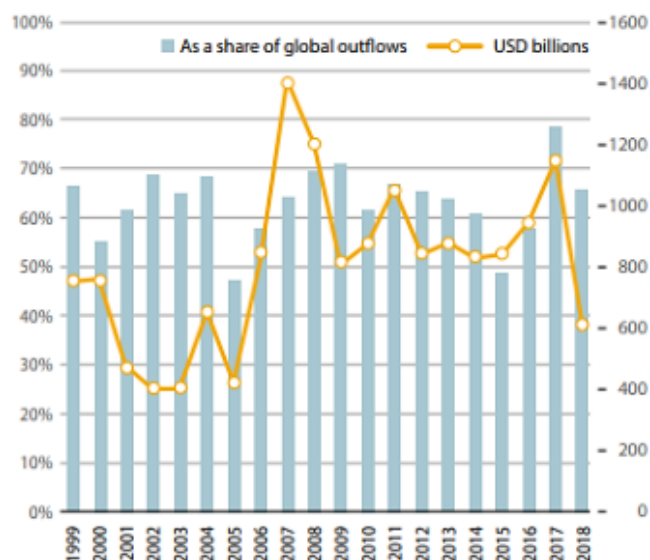
Source: OECD Foreign Direct Investment statistics database

I2U2 AND QUAD: QUAD is more of a security-oriented organization. While economic cooperation is a secondary aspect of the group's agenda, its primary focus is on security issues such as maritime security, counterterrorism, and the promotion of a free and open Indo-Pacific region.

In comparison, I2U2 has shown steps in the direction of economic and sustainable growth which are more promising than that of Quad but it is too early to compare both organizations. As far as contemporary times are concerned, QUAD can be seen more as a defence strategic partnership, focussed on pressing its foothold as hard power, whereas I2U2 has been active on both the economic and environmental front.

The growth of unipolarity cannot adequately explain the recent unilateralism in American foreign policy. However, the US is not destined to abandon its multilateral outlook. Although the United States' position as the world's leading power presents options for unilateral action, the forces and incentives that influence decisions regarding multilateral cooperation are highly diverse and cross-cutting. What is certain is

that the United States continues on a multilateral road with strong forces and incentives, which are based on considerations of economic interest, power dynamics, and political tradition. Even the most ardent unilateralist in Washington today cannot conceive the revolution in American foreign policy that would result from ignoring these constraints and incentives. Because so many nations have embraced the multilateral vision of international order that the United States has espoused for the majority of the twentieth century, the worst unilateral inclinations emanating have drawn harsh criticism from all over the world. Thus, I2U2 will attempt to tilt the path of US foreign policy towards the celebrated path of Multilateralism.

With the arrival of I2U2 collaboration in India's diplomatic space, India will be able to pursue its objective of strategic autonomy while also establishing alliances with powerful allies. India has sought to take an active role in international platforms since its independence. It pursued a 'nonalignment' approach throughout the Cold War while staying 'quasi-aligned' with the Soviet Union. In the current period, it is pursuing "strategic autonomy," yet, it has always attempted to maintain good relations with strong powers, but, given the current geopolitical situation, India faces certain difficult security concerns from its neighbour China. As a result, India is confronting a foreign policy challenge, owing mostly to deteriorating relations

with Pakistan and China. China intends to dethrone the United States as the world's premier power and is exploring the Asia-Pacific area as a platform to accomplish that goal.

Russia has always been a trustworthy ally of India since the cold war. Both countries have strong and strategic ties. But, India is currently in a difficult position, owing to the unpredictability of India's future relationship with Russia which raises numerous basic questions about the country's future strategic policies. So, what are the strategic options available for India? A deeper, broader, and enhanced relationship with the United States and I2U2 provides an excellent opportunity for India to accomplish its goals. The connection with the United States has always been an important part of India's foreign policy, and it may become vital in the years to come. While India and the US have not always been the best of allies and their relationship has been volatile over the years, their evolving perspectives on one another have resulted in a marked improvement in ties that has broken down prior barriers. In addition to joining the Quadrilateral Security Dialogue, the recent two decades' convergence trend demonstrates that India and the United States have signed accords for better trade partnership, besides those pertaining to security, thus, signifying that India is prepared to begin a new partnership with the USA through the I2U2, which will allow the two countries to accomplish goals that the QUAD failed to do.

Conclusion

If we see the history of the formation of any regional organization assuming their international significance, there hadn't been any instance where member countries were friendly with each other. Disputes and conflicts are bound to happen as no country is alike. I2U2 is no longer isolated from this fact. A critical first step in mending ties between Israel and the Arab world is the Abraham Accords. But a few countries are still reluctant to establish formal diplomatic ties with Israel. The conflict between Israel and Palestine is one of the key reasons for this resistance. The group's unity makes the domestic issues among the Arab nations more difficult to solve. The competition between Iran and Saudi Arabia over Shia and Sunni religion has also

had an impact on other Gulf countries. Power imbalances and sect formation may come from these debates.

Also, another issue that India and the US would want to address is the Chinese presence, which is growing in the West Asian area. Israel's Haifa port has been expanded by China. UAE was one of the first countries that got Huawei's (Chinese MNC) assistance for its 5G project. Nevertheless, I2U2 is a win-win situation for all parties involved. In terms of collaboration with West Asia, India has to take a more active role to protect its core interests, including those of its employees, trading partners, investors, and marine security partners. India must negotiate this region, which is rife with landmines. The I2U2

partnership represents a significant change in the geopolitical environment of the area, giving the four nations a chance to improve their collaboration in a variety of areas and combat the rising danger of terrorism and extremism. The collaboration in sectors including security, military, energy, trade, and technology may be further improved by this alliance, which would also help the general stability and prosperity of the region.

With collaboration among the four nations, it will be possible to diplomatically and strategically balance the competitor nations to maintain cordial ties. This partnership is a result of a convergence of interests and shared values, including a commitment to democracy, stability, and economic development.

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Female Labour Force Participation – An Indian Perspective

Kriti Anand

Abstract

The paper explains the theoretical background of the factors which affect the labour force participation rate of women and the importance of FLFPR in economic growth. The research tests the hypothesis of a U-shaped relationship between the female labour force participation rate and per-capita GDP from 1991-2021. It also tries to predict the trend in the FLFPR for the coming years. In India, the growing informalization of the female labour force is becoming a major concern. Economic, social and cultural restrictions also lead to a decline the female participation in the workforce. The trends in the FLFPR in India have been underlined across caste, religion and employment sectors. Women have a higher labour force participation in rural areas than in urban areas due to the growth of casual and informal labour. Policymakers need to understand the factors which affect the female labour force to ensure targeted policies for particular sectors.

Introduction

The Female Labour Force Participation rate (FLFPR) has been a growing concern worldwide in labour markets. Female Labour force participation is an essential study area as it largely influences economic development and gender discrimination in society. As more women enter the labour force, economies have the potential to grow faster in response to higher labour inputs and better utilisation of the potential human capital. In empirical studies, the relationship between Female labour force participation and economic growth is defined using a U-shaped hypothesis. In India, there is no evident relationship between the female labour force participation rate and economic development. However, the declining FLFPR rate has witnessed a rise in the past two years thus showing a potential increasing trend which has been investigated in this research paper. From a global perspective, India has a very low female labour force participation rate. Boserup's (1970,2007) pioneering work predicted that women are largely employed in the informal sector. We can find a similar trend from the Indian perspective, where women are primarily employed in casual low-paying jobs. There are findings of an ambiguous relationship between education and the female workforce. However, higher education improves the social status of women and provides them with the required vocational training.

Large unemployment in India and jobless growth in female employable sectors explain the low FLFPR in India. The research is also exploring the effect of the factors such as urbanisation, gender pay gaps and financial inclusion on female labour force participation.

India has a large concentration of women in the informal and self-employed sectors. Policy-makers need to understand the effect of crucial factors on the female labour force participation rate. The research shows that targeted policies positively affect the female labour force participation rate. Research has been established to show a U-shaped relationship in India. However, the relationship is not evident and the results are divided. The empirical research states a negative relationship between education and FLFPR in India. Growing urbanisation also has an ambiguous effect on FLFPR in India. Social and cultural restrictions play an important role in reducing the participation of women in the workforce.

Theoretical Background

Over the years, research has been done to establish a relationship between Female Labour force participation rate and economic development. Boserup predicted that the feminization of the labour force is largely due to the growing informalization of labour(van der Meulen Rodgers, 2010) (Boserup,

2007). Women are largely employed in the informal sector with lower wages. The U-shaped relation between women's employment and economic development has largely been debated and the finding is more robust for cross-country (static) comparisons(Prava Mishra Assistant Professor, n.d.). The U-shaped Hypothesis has been defined that when incomes are very low, women work in agriculture to support the households. As income rises along with the use of technology, men start dominating the workforce. As development rises, the education level for men rises and much later for women(The_u-Shaped_female_labor_force_function_in_economic_d evelopment_and_economic_history (1), n.d.). At a household level, these structural shifts can be described in the context of the neoclassical labour supply model: as a spouse's wage rises, there is a negative income effect on the supply of women's labour. Once wages for women start to increase, however, the substitution effect will induce them to increase their labour supply(Verick, 2018).

The effect of education on women's participation in the labour force is ambiguous(Psacharopoulos & Tzannatos, 2014). Educated women may choose to work less due to the net income effect. However, as a result of increasing remuneration, the opportunity cost of not working or the cost of leisure increases. This creates an incentive to work more due to the substitution effect. As a result, the net effect of education on FLFPR depends on which of these two effects dominate, giving a backwards-bending supply curve(Malhotra, 2017). The empirical research suggests that in developing countries, there is an inverse relationship between female participation in the labour market and the total fertility rate(Ally Simba & Güneş, 2023). With declining fertility levels, women place greater importance on working, which raises their probability of participation in the labour market and positively impacts economic growth(Klasen & Lamanna, 2008).

Theoretically, the backwards-bending labour supply curve which shows women withdrawing from the labour force at higher levels of income suggests that urbanisation and female labour force participation has a non-linear relationship. However, urbanisation leads to greater opportunities for productive employment and education for women(Urbanisation and Female Labour Force Participation Rate in India, n.d.).

Unemployment levels in the region majorly affect the probability of women finding a job in the labour market. The higher this rate is, the lower the likelihood of getting a job while the associated economic costs will be higher. On account of these reasons, women may feel discouraged from looking for paid work and thus, remain out of the labour force. The "discouraged worker" hypothesis implies, therefore, that unemployment has a negative effect on female labour force participation(Chaudhary & Verick, 2014a).

Empirical research also states that gender pay gaps have a significant impact on women in the labour market. Gender - pay gaps reduce female employment, increase fertility, and lower economic growth through participation and demographic effects(Klasen & Lamanna, 2008). In contrast, Blecker and Seguino suggest that high gender pay gaps and associated low female wages increase the competitiveness of export-oriented industrializing economies and thus boost the growth performance of these countries(Blecker & Seguino, 2002). Financial inclusion is another factor which has a positive impact on female labour force participation. Having their own bank account increases women's economic autonomy and self-employment (Sorsa et al., 2015).

Several theories have been developed to better understand the factors which impact women's choice to participate in the labour force. Human Capital Theory (HCT) considers that female labour force participation (L) is influenced by women's productive economic advantage reflected by their level of education (E), their non-human capital assets (A), the child survival rate after birth (S) and the social environment influence(T). The education of women is generally expected to have a positive impact on labour market participation, and at the same time reduce the number of children born to women (Thaddeus et al., 2022). The Income leisure theory explains that higher wages increase the female labour force participation rate. The income-leisure model examines labour supply in relation to wages and income. The higher the wage rate, the more attractive work becomes(Psacharopoulos & Tzannatos, 2014).

The female labour force participation rate becomes an important study area because of its impact on economic growth. Specifically, in the Indian context, Esteve-Volart (2004) shows that a 10% increase in the female-to-male ratio of workers would increase per capita net domestic product by 8%(Esteve-Volart, 2004). On a household level, a working woman has a bigger say in household decisions which reduces their dependence on men. Increasing women's participation in economic activities is considered necessary for many reasons; it improves their social and economic position and hence leading to an increase in the overall economic efficiency of the nations, it decreases the gender gap in human capital leading to higher productivity of women in the labour force and increases the sectoral share of women employment in different sectors of the economy(Thaddeus et al., 2022). On a household level, a working woman has a bigger say in household decisions which reduces their dependence on men.

Explaining female labour force participation trends in India

In India, the female labour force participation rate is becoming a crucial issue for discussion. India has one of the lowest labour force participation rates for women in the world; more accurately, one of the lowest rates for urban women(Bhalla & Kaur, n.d.). The low female participation in the labour force indicates that India has an untapped human capital potential which can lead to a massive increase in economic growth(Urbanisation and Female Labour Force Participation Rate in India, n.d). Several factors like female education, fertility rate, gender mobility, wage discrimination, availability of jobs, infrastructure, financial availability and socio-economic restrictions affect the female labour force participation rate in India. Due to the unpaid nature of women's work and the definition of economic activity, women's labour force participation remains statistically under-reported. The role played by women in care activities, predominantly their reproductive work and household maintenance, fall outside the system of national accounts in India, whereas the international definitions include the production of goods for self-consumption within the production boundary of the System of National Accounts (SNA)(Chaudhary & Verick, 2014b).

Moreover, jobless growth in sectors that employ more women or seem more friendly to women necessarily limits growth in FLFP(Fletcher et al., 2018).

India has a significantly low female labour force participation in comparison to the male labour force participation rate. According to CMIE, During January-April 2022, male LPR was 66 per cent while female LPR was 9 per cent. While the male LPR for the age group 25-59 years is systematically over 90 per cent, the female LPR has never breached 20 per cent for any age group(CMIE, n.d.).
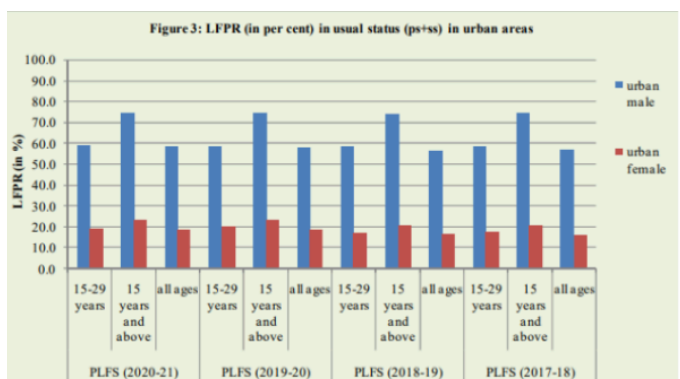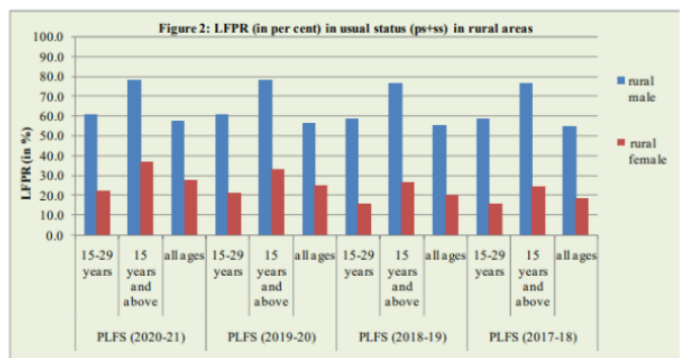

Chart 1 – LFPR (in percent) in rural and urban areas (Source – Annual Report on Periodic Labour Survey 2020-21) (सां & लय, n.d.)

The above chart indicates that labour force participation by men is considerably higher than by women in both rural and urban areas. According to the Periodic Labour Force Survey (PLFS) 2020-21, the Labour force participation for the age group 15-29 is 42.0% in rural areas and 39.9% in urban areas. In India, rural female labour force participation is

more than urban females. This can be explained by higher enrolment by women in secondary education in urban areas. Women in rural areas are more likely than their urban counterparts to work in unpaid family labour(Fletcher et al., 2018).
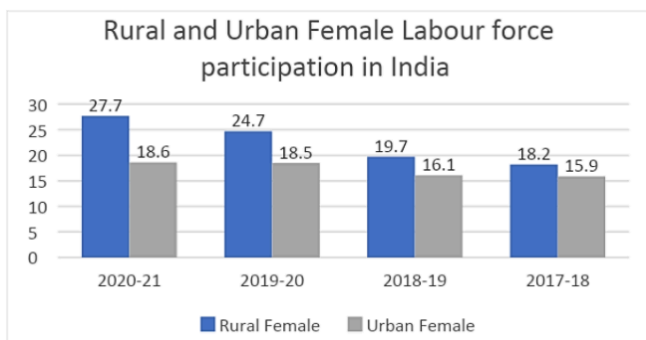

Chart -2 Rural and Urban Female labour force participation rate in India (Source – Annual report, PLFS, 2020-21)

Cultural and societal norms also have a significant effect on women's participation in the workforce. Cultural factors such as a woman's religion and caste can place limits on a woman's right to work(Chaudhary & Verick, 2014a).

Chart 3 – Female Labour force participation across major religious groups. (Source – Annual Report, PLFS, 2020-21)

The above chart shows that Muslims have the lowest female labour force participation rate in comparison to other religions. Low levels of education, combined with little to no specific 'skills', severely restrict the employment options available to Muslim women(Fatima Alvi, 2016).
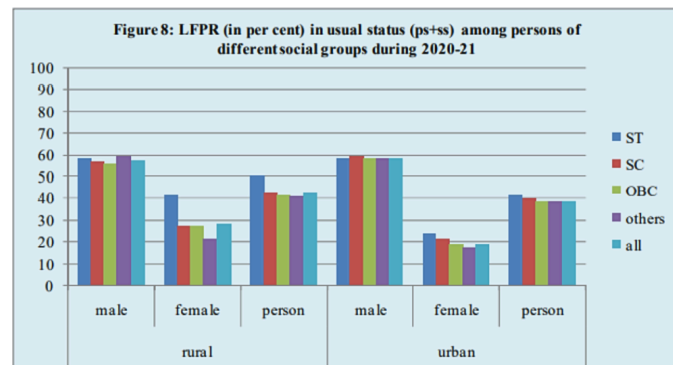

Chart – 4 – LFPR among different social groups during 2020-21
(Source – Annual report, PLFS, 2020-21)

The above chart indicates that SC, ST and OBC women constitute a large part of the female labour force in India. However, this is not a good indicator of their status in the labour market. Fatima(2016) explains that Lower caste women are overwhelmingly concentrated in rural areas, where opportunities to be employed as unskilled marginal and casual labour are abundant. This is the sector that employs the highest proportion of SC/ST women, and if they are increasingly getting pushed into low-paying casual labour, then the higher labour force participation of lower caste women could be a sign of economic distress rather than economic empowerment(Fatima Alvi, 2016).
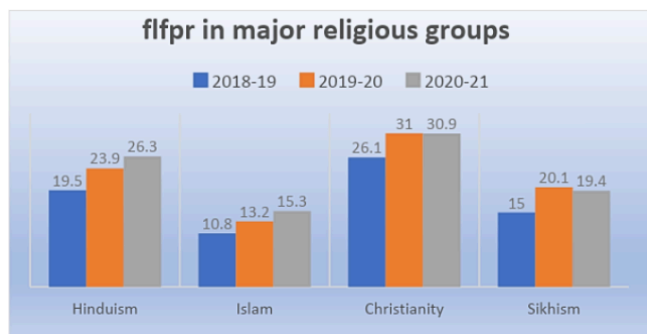
Table (20): Percentage distribution of workers in usual status (ps+ss) by broad status in employment for each industry of work

all-India rural female

industry as per NIC-2008 (2 digit NIC Division codes and corresponding descriptions)	self-employed			regular wage/ salary	casual labour	all
	own account worker, employer	helper in household enterprise	all self employed			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
01-03 (agriculture)	19.9	53.3	73.2	1.1	25.6	100.0
05-09 (mining & quarrying)	0.0	0.0	0.0	41.1	58.9	100.0
10-33 (manufacturing)	61.7	15.8	77.6	14.0	8.5	100.0
35-39 (electricity and water supply)	0.7	0.0	0.7	84.0	15.3	100.0
41-43 (construction)	0.1	0.1	0.3	0.4	99.3	100.0
05-43 (secondary)	34.1	8.8	42.9	8.4	48.6	100.0
45-47 (trade)	52.1	35.7	87.8	11.5	0.7	100.0
49-53(transport)	41.3	4.0	45.2	39.4	15.4	100.0
55-56 (accommodation & food services	25.9	46.4	72.3	17.2	10.5	100.0
58-99 (other services)	8.0	2.1	10.1	86.6	3.3	100.0
45-99 (tertiary)	21.0	13.2	34.2	62.7	3.1	100.0
total	21.9	42.8	64.8	9.1	26.2	100.0

Table 1 – The sectoral distribution of rural female workforce
(Source – Annual report, PLFS, 2020-21)

Table (20): Percentage distribution of workers in usual status (ps+ss) by broad status in employment for each industry of work

all-India   urban   female

industry as per NIC-2008 (2 digit NIC Division codes and corresponding descriptions)	self-employed			regular wage/ salary	casual labour	all
	own account worker, employer	helper in household enterprise	all self employed			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
01-03 (agriculture)	26.9	38.5	65.5	0.7	33.9	100.0
05-09 (mining & quarrying)	0.0	0.0	0.0	67.0	33.0	100.0
10-33 (manufacturing)	54.3	12.0	66.2	25.8	7.9	100.0
35-39 (electricity and water supply)	27.0	1.0	28.0	62.8	9.2	100.0
41-43 (construction)	3.0	0.8	3.8	6.7	89.5	100.0
05-43 (secondary)	45.5	10.0	55.5	23.7	20.8	100.0
45-47 (trade)	39.3	26.3	65.6	30.9	3.5	100.0
49-53(transport)	0.5	5.1	5.6	89.8	4.6	100.0
55-56 (accommodation & food services	22.0	38.7	60.7	25.0	14.3	100.0
58-99 (other services)	10.3	2.1	12.4	85.0	2.6	100.0
45-99 (tertiary)	17.0	9.1	26.1	70.5	3.4	100.0
total	26.0	12.4	38.4	50.1	11.5	100.0

Table 2 – The sectoral distribution of the urban female workforce
(Source – Annual report, PLFS, 2020-21)

Rural females in India are largely employed in the agricultural sector. Moreover, the women are self-employed and highly employed in casual labour. The women employed in casual labour highlight the poor status of women in India. The ratio of self-employed women in rural areas is also very high.

Urban females in India are largely employed in the tertiary sector. The casual labour among females employed in the agriculture sector is high which shows the poor state of women in agriculture in India. Women in large numbers get regular wages and salaries. The manufacturing sector is a large employer for women in India. Fewer women are employed in the tertiary sector as compared to agriculture in the secondary sector.

Another important finding about the trend in the female labour force is that women's participation is higher in the fields with female-oriented schemes such as MGNREGS. MGNREGS (the Mahatma Gandhi National Rural Employment Guarantee Scheme) provides up to 100 days of paid unskilled work per rural household annually. In contrast to the national labour market, which is composed of only 22% women overall, 52% of MGNREGA workers were female in 2016. MGNREGS uses a gender quota, requiring that at least one-third of person-days are worked by females - but the 33% requirement is clearly exceeded, and therefore cannot fully explain such high levels of female participation. Other potential reasons MGNREGS attracts women include its wage parity policy, which may be particularly appealing for unskilled rural women accustomed to large gender wage gaps, and because it

provides work for women near their households(Fletcher et al., 2018). Agriculture and education are the other two sectors which have been seeing a large number of women participation due to targeted policies.

To strengthen policy making, it is important to lookat the future trend of the female labour forceparticipation rate in India and understand the relationship between economic growth and FLFPR in India.

Objective

The objective of this paper is to examine the pattern of female labour force participation in India with its relation to economic growth measured using the per-capita GDP of the country from 1991-2022.
These are the following research questions:

1. Is there a U-shaped pattern of female labour force participation?
2. What is the trend for the female labour force participation rate in the coming years?

Hyphothesis

The following hypothesis emerges from the objective:
Null Hypothesis: India's female labour force participation has followed a U-shaped pattern with its growing per capita GDP and the FLFPR rate will witness a rise in the coming years.

Methodology

Here is the data on India's female labour force participation rate, per capita GDP and Female Literacy rate from 1990-2021 sourced from World Bank indicators: (Source-World Bank)

Female labour force participation and GDP per Capita
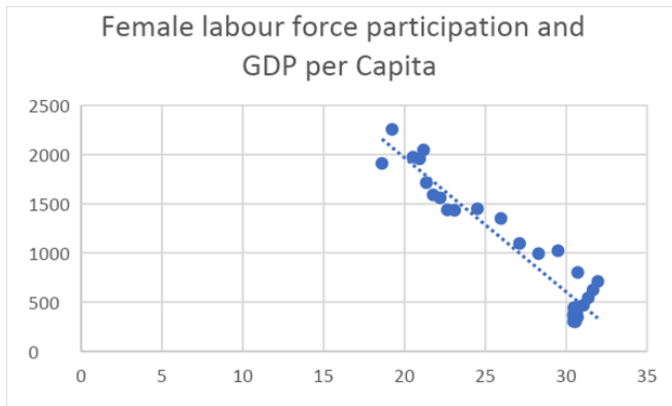
The scatter plot shows a negative correlation between the per capita GDP and the female labour force participation rate. As the per capita GDP has increased, there has been a decline in the female labour force participation rate.

FLFPR from 1990-2021
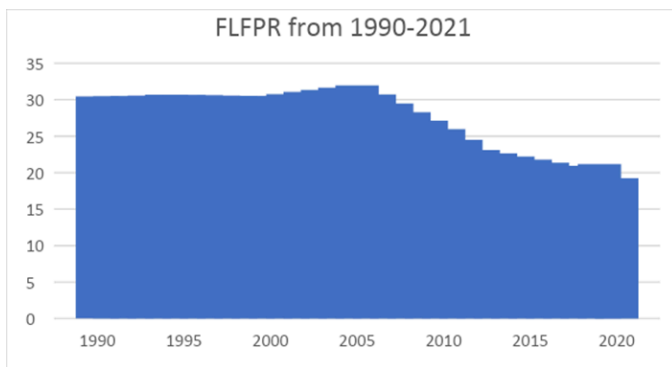
For the regression analysis, the variables are – Female Labour Force Participation rate, Per Capita GDP and female literacy rate.

The regression equation is:

FLFPR = b1 + b2GDP

FINDINGS
SUMMARY OUTPUT

Regression Statistics

Multiple R	0.957632
R Square	0.91706
Adjusted R Square	0.91425
Standard Error	1.31145
Observations	32

	Coefficients	Standard Error	t Stat	P-value
Intercept	33.820 46084	0.4309 96526	78.470 38	2.78E3 6
Per Capita GDP	-0.0067 1885	0.0003 68908	-18.212 8	9.1E-18

The coefficient of Per capita GDP is negative stating the inverse relationship between FLFPR and GDP per capita in India.

Forecast of the FLFPR
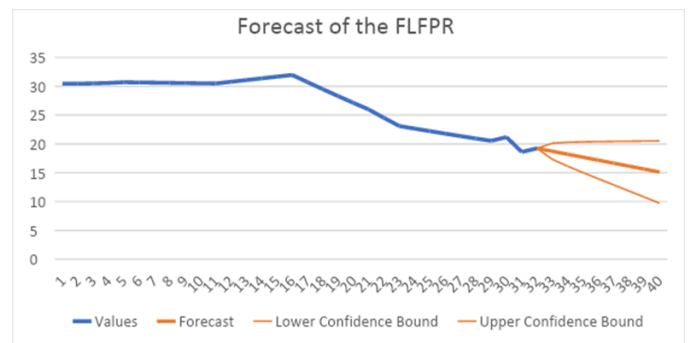
The forecast indicates a declining Female Labour Force Participation Rate in the coming years, showing no indication of U-shaped relation between FLFPR and GDP growth in India in the coming years.

Conclusion and Discussion

There exists no evident U-shaped relationship between per capita GDP and the Female Labour Force Participation rate. The coefficient of per capita GDP is negative stating an inverse relationship between Per capita GDP and Female Labour force participation rate. The forecast shows a declining female labour force participation rate, indicating no potential for a rise in a U-shape. More research needs to be done to analyse the impact of factors such as gender mobility and infrastructure the female labour force participation. Moreover, policymakers should focus on targeted policies to increase jobs in female job-oriented sectors like education and manufacturing. Gender-pay gaps need to be reduced

to incentivize women to participate in the workforce. The measurement indicators need to be improved to include self-employed women and household amenities. Policy framework plays an important role in increasing labour force participation despite the existing socio-economic restrictions. The growing era of digitisation raises opportunities for awareness regarding jobs and employment opportunities for women. The government should focus on making women media literate and increase awareness among them.

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Navigating the Risks and Rewards of Climate Change in the Indian Economy

J Sujith Kumar

Abstract

This article provides a sector-wise analysis of the risks and opportunities of climate change for the Indian economy. The impacts of climate change on key sectors such as agriculture, water resources, energy, and tourism are examined, along with the opportunities for each of these sectors. The article highlights the significant challenges posed by climate change to the Indian economy, which is highly dependent on natural resources and vulnerable to extreme weather events. However, the article also shows that climate change presents opportunities for innovation, investment, and sustainable growth in renewable energy, green infrastructure, and sustainable tourism. The article concludes with a set of recommendations for the Indian government to navigate the risks and rewards of climate change. The recommendations include specific policy measures that can be implemented to promote climate-resilient and sustainable development, such as crop insurance schemes, precision agriculture, agroforestry, feed-in tariffs for renewable energy, energy efficiency measures, and carbon taxes.

Introduction

Climate change is one of the most pressing global challenges of our time, with far-reaching impacts on human societies and ecosystems. Rising global temperatures, changing precipitation patterns, and extreme weather events are just some of the consequences of climate change, which threaten to undermine the social, economic, and environmental progress achieved in recent decades. The effects of climate change are especially acute in developing countries like India which are highly vulnerable to its impact due to their reliance on natural resources and the high exposure of their population to extreme weather events.

The Indian economy is one of the fastest-growing economies in the world and it is the world's second-largest producer of wheat, rice and other cereals, and agriculture is the primary source of livelihood for millions of people. Water scarcity, extreme weather events, and changing precipitation patterns are already affecting crop yields and food security with significant implications for poverty reduction and human development.

At the same time, climate change also presents opportunities for innovation, investment and sustainable growth. Renewable energy, green infrastructure and sustainable tourism are just some of the sectors that can benefit from the transition to a low-carbon economy, creating new jobs and enhancing economic resilience.

Literature Review

Numerous studies and reports by international organizations, government bodies, and research institutions have emphasized the potential risks and opportunities related to climate change. The IPCC's (2014) report on climate change impacts, adaptation, and vulnerability provides a comprehensive overview of the potential impacts of climate change on different sectors, including agriculture, water resources, human health and ecosystems, as well as strategies and measures to adapt and mitigate the impacts.

Studies by Rasul (2021), Fant et al. (2016), Sapkota et al. (2019), Vajjarapu et al. (2019), Gulati (2018), and Nakano et al. (2017) identify climate-related challenges and suggest possible adaptation and mitigation strategies in sectors such as agriculture, water resources, transportation, and renewable energy. These studies provide valuable insights into the challenges and opportunities associated with climate change, highlighting the need for immediate

action to address them.

Overall, the literature not only underscores the significant risks of climate change to the Indian economy and its people but also offers potential opportunities for resilience building and sustainable development through adaptation and mitigation measures.

Objectives

- Examine the impact of climate change on key economic sectors in India including agriculture, water resources, energy, and tourism
- Analyse the risks and opportunities of climate change for each sector, taking into account the unique challenges and opportunities presented by climate change
- Explore the adaptation opportunities for each sector including policy and institutional frameworks that can support the transition to a low-carbon economy and enhance economic resilience
- Provide insights and recommendations for policymakers, researchers and other stakeholders to address the complex challenges of climate change and economic development in India

By addressing these objectives, this article aims to contribute to a better understanding of the interplay between climate change and economic development in India and to guide policy and decision-making toward a more sustainable and resilient future.

Policy and Institutional Frameworks

India has developed various policies and frameworks to address the challenges of climate change and its impacts on the economy, including the agriculture sector. One of the key policy documents is the National Action Plan on Climate Change (NAPCC), which outlines India's strategies for adapting to and mitigating the impacts of climate change. The NAPCC includes specific strategies for the agriculture sector, such as improving water use efficiency, promoting organic farming, and developing climate-resilient crop varieties. In addition to the NAPCC, India has also developed sector-specific policies for agriculture, energy, and other sectors that aim to reduce greenhouse gas emissions and promote sustainable development.

India is a signatory to various international agreements and commitments related to climate change, such as the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels and calls for countries to submit nationally determined contributions (NDCs) that outline their targets for reducing greenhouse gas emissions. India's NDC includes a goal of reducing the emission intensity of its GDP by 33-35% by 2030 compared to 2005 levels and increasing its share of non-fossil fuel energy sources to 40% of installed capacity.

Sector-Wise Analysis

AGRICULTURE

Climate change poses significant risks to the agricultural sector in India. Rising temperatures and changes in precipitation patterns lead to extreme weather events such as droughts and floods, causing water stress and reduced soil fertility. This, in turn, leads to lower crop yields, lower incomes for farmers, and an increase in food prices for consumers. Changes in pest and disease dynamics, pollinator populations, and crop distribution also affect the overall productivity of the sector, leading to changes in land use and a loss of natural habitats. It is crucial to mitigate the impact of climate change on agriculture to ensure food security, preserve biodiversity, and promote sustainable economic growth.

While the risks of climate change to the agricultural sector are significant, there are also potential rewards. Climate change could increase crop productivity, with longer growing seasons and warmer temperatures being beneficial for certain crops, leading to higher yields and increased output. The expansion of crop ranges may also be possible, leading to a wider range of crops being grown across the country. Climate change also presents new opportunities for innovation in the sector as farmers adopt new technologies or techniques to adapt and remain productive. Growing a diverse range of crops can help improve soil health and reduce reliance on a single crop, which can benefit for both food security and economic growth.

WATER RESOURCES

Changes in precipitation patterns and increased variability and intensity of rainfall are leading to more frequent droughts and floods, disrupting water availability and quality, particularly in regions that are already water-stressed. Melting glaciers are contributing to the depletion of water resources, particularly in the northern and north-western regions of the country, which will most likely impact agriculture, hydropower generation, and urban development. In addition, water scarcity and poor water quality can have negative effects on health, education, and livelihoods, particularly for marginalized communities and women.

Climate change poses significant risks to water resources in India, including changes in precipitation patterns and increased water scarcity. However, it also presents opportunities such as the promotion of sustainable water management practices and innovation in the water sector. This includes the development of water-efficient technologies and investment in infrastructure for efficient water storage and distribution. The adoption of such practices can increase water resource efficiency and contribute to the adaptive capacity of the Indian economy to climate change. Furthermore, greater investment in water infrastructure could lead to new economic opportunities in the construction and engineering sectors, as well as improved water security for communities across the country.

ENERGY

Climate change poses significant risks to the energy sector in India, including changes in demand and supply patterns, infrastructure damage due to extreme weather events, and increased costs associated with adapting to climate change effects. Changes in precipitation patterns and rising temperatures can affect energy demand and supply, especially in the hydropower and renewable energy sectors. Furthermore, extreme weather events such as floods and cyclones can damage energy infrastructure, causing outages and increasing repair costs, disrupting industry and commerce. For instance, in 2017, Cyclone Vardah caused extensive damage to power infrastructure in Tamil Nadu, resulting in power outages and disruptions to industry and commerce.

The shift towards renewable energy sources such as solar and wind power could be a potential reward of climate change to the energy sector in India. As the costs of these technologies continue to decline, greater adoption can lead to a reduction in greenhouse gas emissions, improve energy security, and create new economic opportunities. Moreover, the need to mitigate emissions could drive innovation in energy efficiency and low-carbon technologies. The shift away from fossil fuels could also contribute to improving air quality and public health, reducing social costs associated with air pollution and related health impacts. Ultimately, the rewards of climate change in the energy sector are closely linked to the adoption of sustainable and low-carbon technologies, which can help to reduce emissions and create new economic opportunities in the Indian economy.

TOURISM

Climate change poses significant risks to India's tourism industry, including altered tourist seasons, extreme weather events, sea level rise, coastal erosion, and indirect impact on food supplies and ecotourism activities. These risks can lead to lower visitor numbers, revenue losses, and changes in perceptions of certain tourist destinations, ultimately affecting the growth and stability of the tourism industry.

However, climate change may also present some opportunities for the tourism industry in India. Rising temperatures and changes in precipitation patterns could create new opportunities for tourism, and the need to adapt to climate change could lead to the innovation of new products and services. These rewards are closely linked to the industry's ability to develop sustainable and innovative solutions that can attract and retain visitors to the Indian economy. The tourism industry in India must carefully manage the risks and rewards of climate change to ensure its long-term growth and sustainability.

By doing so, the tourism industry in India can play a critical role in contributing to the country's economic growth and development while also promoting sustainable and responsible tourism practices.

Recommendations

India can adopt various agricultural practices implemented in other countries to improve resilience to climate change. These practices include implementing a crop insurance program to protect farmers against weather-related risks, promoting precision agriculture through technology adoption and financial support, promoting agroforestry to enhance biodiversity and soil health, and promoting climate-smart agriculture through incentives and technical support. To improve water resource management, the government can implement a water pricing policy that charges higher prices for excessive use of water resources and encourages the conservation and reuse of water. The Indian government can also promote the adoption of water-efficient technologies such as drip irrigation, provide financial incentives and technical support to farmers and households to adopt these technologies and invest in infrastructure for efficient water storage and distribution. The government can also prioritize conservation efforts for vulnerable ecosystems such as wetlands and promote community-based management approaches.

The Government must also take actions to promote renewable energy and energy efficiency, including implementing a feed-in tariff system, promoting energy efficiency in buildings and industries, developing a national energy storage strategy, introducing a carbon tax, and investing in research and development for renewable energy technologies. These measures can provide financial incentives, support grid integration, reduce carbon emissions, and encourage innovation in the renewable energy sector.

To promote sustainable tourism practices in the country, India can learn from sustainable tourism policies implemented by Spain and Costa Rica. The government can collaborate with the private sector and civil society organizations to develop a comprehensive sustainable tourism policy framework, which includes guidelines for sustainable tourism practices, incentives for environmentally friendly tourism businesses, and measures to protect cultural heritage sites and natural resources.

This framework can also include measures to promote sustainable transportation and support local communities. India can adopt several measures to improve its resilience to climate change, including implementing agricultural practices to enhance adaptive capacity, improving water resource management, promoting renewable energy and energy efficiency, and implementing sustainable tourism policies. These measures can not only help mitigate the impacts of climate change but also provide economic and social benefits to the country.

Way Forward

In conclusion, climate change poses significant risks and opportunities for the Indian economy across various sectors, from agriculture and water resources to energy and tourism. While the impacts of climate change may seem daunting, there are numerous adaptation strategies and opportunities that can be pursued to mitigate risks and maximize benefits.

Moving forward, policymakers must prioritize climate change mitigation and adaptation efforts to protect the Indian economy and society from the worst impacts of climate change. This will require collaboration between government, industry, and civil society to develop and implement policies and practices that support sustainable development and protect vulnerable populations. By taking proactive steps now, India can position itself as a leader in climate change adaptation and resilience, and ensure a sustainable and prosperous future for all.

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2

Influence Of Gender On Consumer's Buying Behaviour

Devanshi Mahajan, Khushi Goel, Kritika Agarwal

Abstract

Consumer behaviour is the study of how people select, utilise, and exchange goods, services, events and concepts. It is crucial because it enables companies to comprehend their customers' needs, wants, and desires and develop products in line with the same. It is crucial for organisations to recognize consumer preferences because it can aid in improved decision-making regarding their goods and services. Businesses can modify their services to effectively meet the requirements and desires of their target market by comprehending why consumers buy specific products and their utility. As a result, studying consumer behaviour becomes crucial. Gender is one of the most important factors impacting consumer purchase behaviour. One's perceptions, ideas, and decisions are influenced by their gender. Therefore, there is a variation in how each person thinks before making a purchase. This study aims to understand how a consumer's gender influences their choice. Primary sources are used to gather data for the same in the form of an online survey that is created with Google Forms. Pie charts are used to illustrate the collected data after being arranged in frequency and percentage tables. The results and inferences are based on previous research on related subjects that either coincide with already existing trends or tend to deviate from what existing studies say. According to the conclusion, studies on the subject should be carried out periodically because trends, perceptions, and social situations are constantly evolving.

Keywords: Consumer Behavior, Gender, Buying decisions

INTRODUCTION

Historical Background of Gender and Consumer's Buying Behavior

In economics, the relationship between gender and consumer's buying behaviour is well known. A lot of studies have been conducted to know the relationship between the two. Since it is essential to know how a consumer processes and makes his buying decision, a number of efforts have been made to establish the theory between gender and consumer's buying behaviour.

Significance of Gender in Consumer's buying decisions

The key to market success is to understand consumer purchasing behaviour. The study of behaviour explains how people use products, services, ideas, and experiences to meet their needs. It is difficult to construct a rational and consistent relationship between industry and buyer until consumer behaviour is recognized. Organizations and businesses that adapt

Thus it becomes equally important to study the factors that affect the buying decisions of consumers. Out of all the other characteristics, gender has a considerable impact on consumer purchasing behaviour. Due to the differences in perceiving abilities between genders, each makes a distinct choice while purchasing a good or service.
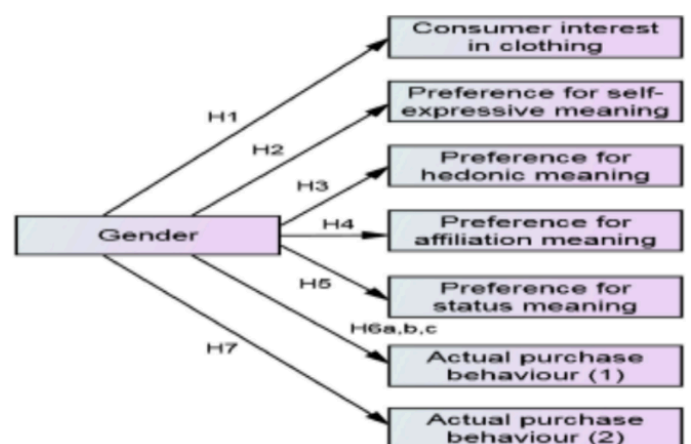
Scope of the study

When it comes to developing a theory to explain their relationship, gender and consumer purchasing

behaviour are frequently contentious. The results of this study may or may not change from previous ones because it was conducted relatively recently and is specifically targeted at younger consumers with no current source of income. This paper takes into account five factors that affect each gender differently. These are brand loyalty, time and effort, social obligations, the effect of sales incentives and advertisements and peer pressure.

Review of Literature

Gender and consumer purchasing behaviour has been the subject of research by several academics. Due to the differences in grooming, socialization, and other factors including social and psychological perceptions and attitudes, males and females have different product preferences. They are likely to have varied ways of thinking and deciding upon their buying choices. Numerous academics have conducted research to demonstrate the significance of the impact of gender on consumer purchasing decisions. The existing studies focus on how men and women approach shopping differently due to varied motivations, ideologies, and other elements that affect how they evaluate potential purchases. The available research emphasizes different aspects to analyze the influence of gender revolving around factors like time, place of purchase, and social restrictions and also highlights how psychological, societal, and personal factors influence buying choices of each gender.

1. **Moschis (1981), Babin Darden, and Griffin (1994)** found that male and female consumers are identified by different approaches with different behaviour and shopping styles, which affect their buying decisions accounting for different traits in their shopping; men can be brand loyal or quality conscious.

2. **Under Hill (1999)** observed that men move faster through the store, spend less time browsing and do not typically ask questions. Men prefer eye-catching displays technology, gadgets and obtaining information first-hand from written materials.

3. **Mcleod (2005)** observed that to understand the social pattern of consumers' purchasing decisions, it is important to classify consumers into different genders. Different genders are subject to different social restrictions and thus it creates a difference in their buying patterns.

4. **Akturan (2009)** argued in their conclusion that gender has a significant part in consumer behaviour

s since men and women have distinct expectations, lifestyles, needs, and wants, which are reflected in their consumption behaviour and influence their purchasing decisions.

5. **Vijaya Lakshmi (2017)** quoted in their study that gender is a very important factor; it plays a very crucial role in purchase decisions. Women are more internally focused whereas men ought to be externally focused. Gender shapes different characteristics of female and male shoppers. It has been suggested that male and female consumers demonstrate considerably different approaches in their decision-making and purchasing behaviour when shopping. They also highlighted that women want more interactions whereas men, a quicker answer.

6. **Friedmann and Lowengart, (2019)** found out that men emphasize instrumental aspects such as functional and socially conspicuous utilities while forming a single brand preference, but women like purchasing low-involvement level product

Research Objective

The purpose of this study is to determine how gender affects a consumer's decision to buy a product, in view of different factors namely; time and effort, marketing and peer influence, social constraints, and brand loyalty.

Research Methodology

Sample Framework

The objective of this research is to understand how a consumer's gender, as a personal element, influences their purchasing decisions. A total of 300 responses,150 from each gender, were gathered to accomplish this. Majority of the respondents were from the North Indian States, including Delhi, Haryana, Punjab, Rajasthan, and a few other states. The respondents range in age from 18 to 23, are enrolled in higher education, and are not actively employed. This research is a qualitative analysis of how gender affects consumers' buying decisions. It is carried out by collecting primary data through random sampling methods. This data is gathered through an online survey created on Google Forms with Excel being used to describe the results. In addition, a few secondary data sources such as newspapers and research articles are employed that complement in drawing conclusions about the results.

Hypothesis

The study is conducted on the basis of the following hypothetical statements:
- Men are more brand cautious.
- Men prefer to save time while purchasing.
- Women are more socially obligated while making a purchasing decision.

Data Presentation

Pie charts and tables are used as visualisation tools to present the primary data collected via an online survey questionnaire. The five factors taken under consideration are:
1. Brand Loyalty
2. Time
3. Effect of Sales Incentives and Advertisements
4. Peer Pressure
5. Social Obligations

The data for each factor is presented as follows:

A)Do you prefer a product hunt over a quick procedure while shopping?

Answers	Frequency	Percentage
No	110	73%
Yes	40	27%
Grand Total	150	100%

Table A.1: Male Responses

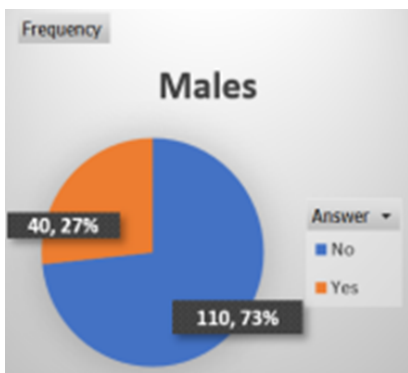| Answers	Frequency	Percentage
No	19	13%
Yes	131	87%
Grand Total	150	100%

Table A.2: Female Responses

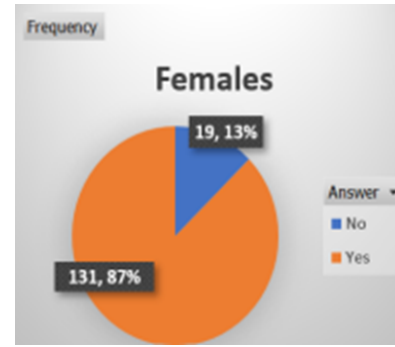

Chart A.1: Pie chart for male responses

Chart A.2: Pie chart for female responses

Observation

The results of this study show that women are more likely to engage in product hunting. The time-consuming nature of their shopping was reported by 92% of women. However, a contrary pattern was seen in the case of men. A quick and simple shopping experience was favoured by 85% of men.

B)Do you feel socially restricted while making a purchasing decision?

Answers	Frequency	Percentage
No	113	75%
Yes	37	25%
Grand Total	150	100%

Table B.1: Male Responses

Answers	Frequency	Percentage
No	19	13%
Yes	131	87%
Grand Total	150	100%

Table B.2: Female Responses

Observation

The results show that women are more likely than men to let social duties influence their purchase decisions. 87% of the female respondents make their purchase decision by taking social obligations into account. Men's behaviour, however, followed a distinct trend. Only 25% of men are subject to social obligations while making a purchase decision.

C) Do you often get influenced by sales incentives and advertisements?

Answers	Frequency	Percentage
No	26	17%
Yes	124	83%
Grand Total	150	100%

Table C.1: Male Responses

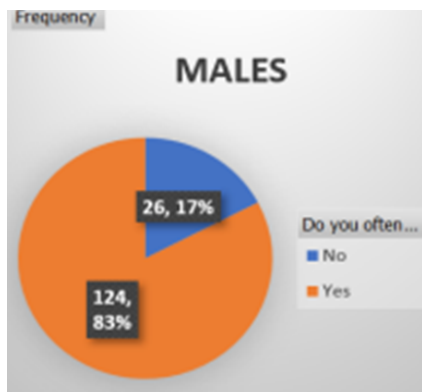| Answers	Frequency	Percentage
No	128	85%
Yes	22	15%
Grand Total	150	100%

Table C.2: Female Responses

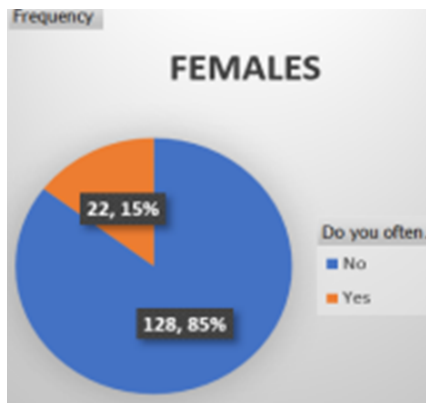**Chart C.1:** Pie chart for male responses

Chart C.2: Pie chart for female responses

Observation

The findings indicate that men are more prone than women to be influenced by sales incentives while making a purchase choice. 15% of female respondents said that they are influenced by sales incentives. However, a different pattern was observed in the case of men. They are persuaded by sales incentives to a degree of 83%.

D) Do the purchase decisions of your peers frequently affect yours?

Answers	Frequency	Percentage
No	26	17%
Yes	124	83%
Grand Total	150	100%

Table D.1: Male Responses

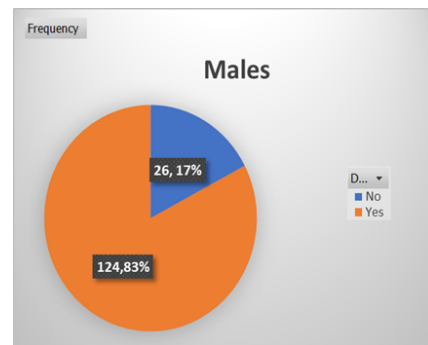| Answers	Frequency	Percentage
No	126	84%
Yes	24	16%
Grand Total	150	100%

Table D.1: Male Responses

Chart D.1: Pie chart for male responses
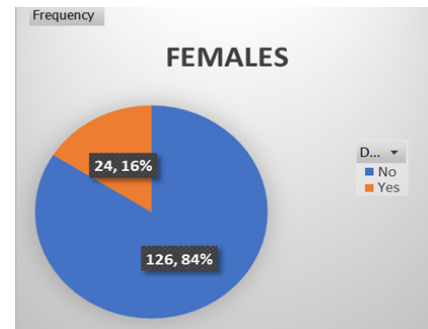
Chart D.2: Pie chart for female responses

Observation

The findings demonstrate that in contrast to women, men experience peer pressure while making a purchase decision. Men have to deal with peer pressure while making purchases in about 83% of cases. However, a different pattern was observed in the case of women. Only 16% of women contend with peer pressure

E) Do you prefer to stay brand loyal or prefer low-priced products?

Answers	Frequency	Percentage
No	113	75%
Yes	37	25%
Grand Total	150	100%

Table E.1: Male Responses

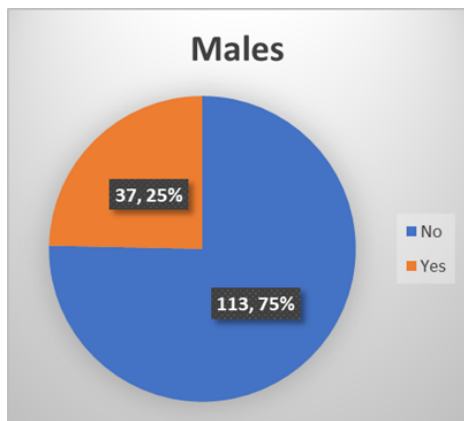| Answers	Freuency	Percentage
No	19	13%
Yes	131	87%
Grand Total	150	100%

Table E.2: Female Responses

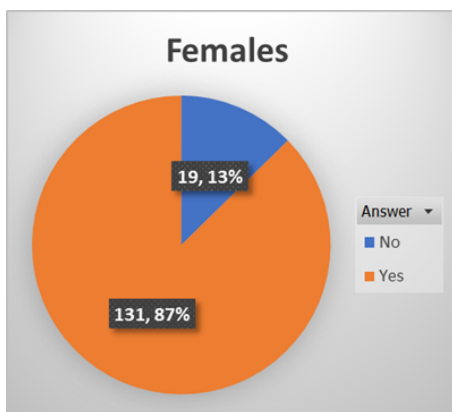**Chart E.1:** Pie chart for male responses

Chart E.1: Pie chart for male responses

Observation

The findings demonstrate that women are more brand loyal. 87% of women claimed that they are brand loyal. However, a contrary trend was observed in the case of men; roughly 27% of men showcased brand loyalty.

ANALYSIS AND INFERENCE

1. Product Hunt vs Easy Shopping Procedure

Inference:
This claim supports the paper's hypothesis, which states that men tend to save time while making purchases. The potential rationale for this claim could be clarified with the help of existing studies. According to Darle and Smith (1995), women tend to spend more time shopping since they prefer to do more research on the things they wish to buy. Another significant claim that helps in verifying this result is, Under Hill (1999) citation, "Men tend to walk through stores more quickly and rarely ask inquiries." We can therefore conclude that men prefer to spend less time shopping. In a study titled, "Men Buy, Women Shop", researchers at Wharton's Jay H. Baker Retail Initiative and the Verde Group, a Toronto consulting firm, found that women react more strongly than men to personal interaction with sales associates and thus prefer devoting more time while making buying decisions.

2. Social Obligations

Inference:
This assertion confirms the paper's central argument, which states that women incur more social obligations when choosing what to buy. The potential basis for this assertion could be grasped with the aid of recent investigations. According to Mcleod (2005), it is important to classify consumers into different genders to assess the social pattern of consumers' purchasing decisions as different genders are subject to distinct social restrictions. Thus, it creates a difference in their buying patterns.

Despite being written in a relatively recent era, this research shows that there are still social limitations that impact women's purchasing behaviour. This may be due to the environment in which they are raised and their inherent fear of being judged. The conventional wisdom holds that men should lead families in important purchase decisions, and women should follow suit. Therefore, it follows that women still have greater social obligations than men.

3. Effect of Sales Incentives and Advertisements

Inference:
This claim contradicts the paper's thesis, which holds

that men are unaffected by sales incentives. The potential rationale for this claim could be understood with the help of existing studies. According to Under Hill (1999), men like eye-catching displays, cutting-edge technology, and gadgets. They are more oriented towards the bottom line and are susceptible to sales incentives. The cause could be their greater concern for money. Men are more attentive consumers, paying more attention to a product's characteristics and looking for more money-saving schemes.

4. Effect of Peer Pressure

Inference:

According to this study, peer pressure affects men more than it does women. This claim, however, runs counter to the earlier hypothesis. A few already existing research explain how peer pressure impacts consumers' purchasing decisions. The observed result could be accounted to the fact that men frequently give in to peer pressure; they have a strong predisposition to make decisions and act in ways that favourably meet their peers' expectations. Males might be keener to blend in and stand out in their acquaintance networks, which is another rationale for this observation.

5. Brand Loyalty

Inference:

This assertion contradicts the paper's hypothesis that men are brand loyalists and quality conscious. Moschis (1981), Babin Darden, and Griffin (1994) found that male and female consumers are identified by different approaches with different behaviour and shopping styles, which affects their buying decisions, accounting for different traits in their shopping. Also, one important observation of their research was that men can be brand loyal or quality conscious. This theory contradicts our results. The reasons can be the income constraint, age factors and demographic conditions. Being brand loyal may be the opposite behaviour when it comes to carefully expending money because branded goods tend to be on the pricey side and men are viewed to be more accountable for the family's income and financial decisions.

Limitations

It is equally important to highlight the limitations of

the study as it may affect the conclusions otherwise. Following are the limitations:

1. It is well known that the economic condition of a consumer can influence their buying decision to a huge extent. This study does not take the economic status or income levels into account.

2. Age is another crucial factor to be kept in mind while generalising the consumers buying decisions. However, the respondents of this study belong to a relatively younger age group i.e. 18 - 23 years that are generally involved in their higher studies and thus are assumed to be not earning.

Findings

According to our research, 92% of female consumers like to explore products before making a choice. However, 85% of men want a quick and simple shopping experience. This can be due to the fact that males tend to shop for more utilitarian reasons than women, who typically shop for hedonistic reasons. Furthermore, about 87% of women and 25% of men said that societal constraints or obligations influence their purchasing decisions. The stark disparity between the number of men and women in this situation suggests that women still face more social limitations than men. Moreover, we see that whereas 83% of men believe that commercials and sales incentives have an impact on them, only 15% of women share this belief. This could mean that since males are more money conscious than women, they appreciate sales incentives more. Our findings show that 92% of females prefer to hunt while making a purchasing decision. However, 85% of the males look for a quick and easy shopping procedure. Besides, 83% of males felt that their purchasing decisions are affected due to peer pressure. However, only 17% of females are affected by their peers. Furthermore, compared to 27% of men, 87% of women desire to remain brand loyal. This is explained by the fact that women are more likely than men to think that a certain brand provides better service and higher quality.

Conclusion

Finally, we may state that there exists a dynamic relationship between consumer buying behaviour and gender. Over a longer time frame, it cannot remain static. Sensitive variables including societal beliefs, time, personal preferences, and the type of consumer

can all have an impact on gender, whether directly or indirectly. Therefore, research must be done at periodic intervals. The findings of this paper are in accordance with this inference as the respondents in this study are younger and presumptively unemployed. Data was gathered for this paper from primary sources with the aid of an online questionnaire. Pie charts were then used to illustrate the gathered data. As a result of the observations, a conclusion was drawn. Finally, out of the five factors examined in this paper, which are brand loyalty, social obligations, the effect of sales incentives and advertisements, peer pressure and product hunting, it may be concluded that as times have changed, while some factors such as brand loyalty have demonstrated gender-specific trends that diverge from those suggested by earlier studies, the results are still consistent with aspects like social obligations and product hunting. Therefore, we can generally conclude that gender is a significant element influencing consumer purchasing behaviour. However, the trend is constantly shifting due to changing contexts and scenarios.

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Search Engine Optimization and Search Engine Marketing (Pay-Per-Click) Strategies in the Cosmetics Segment

Srishti Wadhwa

Abstract

"If you're going to post content on your site anyway, you might as well take time to make sure Google takes notice of your effort". In this study, the association between website owners' investments in search engine optimization (SEO) and search engine marketing (SEM)-pay-per-click (PPC), in the cosmetics segment is examined. Data were acquired from Google search results after utilising various types of keywords(Informational, Navigational, Commercial etc.) for research. The research method employed in this study incorporates an empirical field experiment strategy in which the implementation of both SEO and SEM-PPC are evaluated. Websites that appeared in the top ten sponsored results in searches were noted. Then the keyword difficulty percentage is checked in order to show how hard it would be for a website to rank organically.

Introduction

"If your business is not on the Internet, then your business will be out of business"- Bill Gates.

With an estimated $5 Trillion global e-commerce sales in 2022 and out of that around $11.15 billion for the Cosmetics Segment alone, it makes financial sense to acknowledge this trend. A search engine is essential for getting discovered by the appropriate audience at the appropriate moment. There are two ways a customer will find a business website via a search engine: through organic result listing (based on search engine optimization, SEO) OR a pay-per-click listing (based on search engine marketing, SEM).

A majority of internet marketers prefer PPC over other SEM tactics. A company can find a lot of potential customers online by using SEM methods like SEO and PPC. Both of these approaches have pros and cons of their own. For example, PPC can guarantee a website will be featured right away and, furthermore, it can guarantee good rankings, presuming a high bid price and quality score. PPC can be expensive, especially with the increasing competition for prominent keywords. On the other hand, SEO may be less expensive to implement but cannot guarantee high positions. Each search engine has its own requirements, which means that a website optimised for one search engine is ineffective for all other search engines. This is the major barrier to developing an efficient SEO programme.

There are empirical studies that provide suggestions for internet marketers looking to increase traffic to their websites while running concurrent PPC and SEO campaigns. The goal of this study is to compare Competitive Densities (Difficulty in PPC campaigns) and Keyword Difficulty (Difficulty in SEO)

Background

The term "web" refers to a certain type of virtual online area where all information was systematically stored as papers, photos, videos, and files that were identifiable by Uniform Resource Locators.
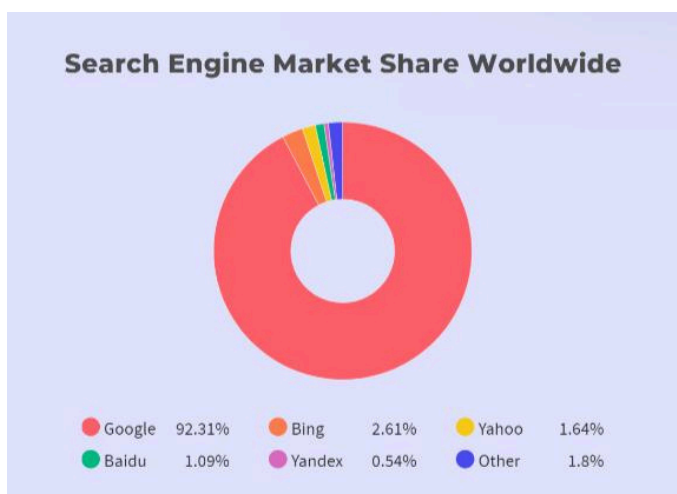
In the past, it was exceedingly difficult to share information or converse. The introduction of the World Wide Web, however, made it possible to share content via other networking sites, blogs, photos, and videos. The www is now ingrained in daily life. It ranks among the most crucial online services. A lot of us find it impossible to go even for one hour without using the Internet.

Today, the Web has developed into a potent instrument for business, and it continues to draw millions of companies. The primary application areas are- Publicity, Marketing and Advertising, Direct online sales, Innovation and research, Collaboration and dialogue etc.

This underlines the need of making sure a website is accessible to search engines.

Search Engines

A user can submit a search word or make several selections from directories that are related to their query using search engine software. The search engine software then checks the search phrase against the contents of an index file that contains data on countless websites. The user is provided with matches through the front end. The top search engines on the internet include Google, Yahoo, MSN, Ask, and AOL. Search engines have received accolades for their capacity to swiftly find a wide variety of information on a wide range of topics.

Search Engine Market Share Worldwide

| ● Google | 92.31% | ● Bing | 2.61% | ● Yahoo | 1.64% |
| ● Baidu | 1.09% | ● Yandex | 0.54% | ● Other | 1.8% |

Search Engine Marketing

Sullivan(2001a) coined the term "SEM" to describe a wide range of tasks associated with SEO, monitoring PPC listings, submitting websites to directories, and creating online marketing plans for companies, organisations, and individuals.

Additionally, SEM was described by Sullivan(2010) as a type of Web marketing that aims to promote websites by enhancing their exposure in search engine result pages (SERPs). Methods include SEO, PPC, contextual advertising, digital asset optimization and paid inclusion etc.

In an e-commerce environment, search engines can be used for two different kinds of marketing activities. First, businesses can pay to have links to their websites appear in the sponsored portion of search engine results pages. PPC is the term for this. Second, businesses use SEO to execute a number of strategies in an effort to raise the ranking of their websites in search engine organic results—all without paying search engines directly.

Pay- per click

PPC was developed as a way for search engines to make money. PPC, or "Pay for Placement," is a term used to represent a number of overlapping strategies that essentially refer to associating particular websites with particular keywords in exchange for payments. By choosing keywords that their specific target market will employ in a search, potential customers are consequently brought straight to a website. PPC requires marketers to pay each time a customer clicks on a sponsored link.

PPC services are typically available on search engines as a way to make money. Microsoft AdCentre is managed by Bing, Google handles Google AdWords, and Yahoo! has Yahoo! Search Marketing. At their favourite PPC search engine, businesses can submit bids on search phrases. Each time a user clicks on the search engine results page (SERP) link leading to the company's website, the bid indicates how much the business is willing to pay the search engine.

Search Engine Optimization

The method of increasing website visibility is known as SEO, and it entails creating and changing webpages to achieve SERP ranking. SEO is also known as the technique of increasing a website's volume and quantity of search engine traffic from natural or organic search results for specified keywords.

Given that more than two-thirds of search engine users only look at the first few pages of search results, it is crucial to rank well in a SERP for queries on certain terms. Therefore, if a website is not among the top 30, it has essentially little chance of being read by a user.

Keywords

Individual words or phrases known as keywords are used to describe the material on a website. They help organise a lot of material into digestible, searchable words and phrases, which benefits both users and web page administrators.

There are four primary categories of keywords, according to the majority of SEOs:-

• Informational keywords – people looking for general knowledge or a response to a specific topic.
Example- Difference between foundation and concealer
• Navigational keywords – people using search engines to locate a certain website or page.
Example- Loreal and Sugar
• Commercial keywords — people conducting product or service research.
Example- Moisturizer Review, Cosmetics
• Transactional terms — users looking to make a purchase or perform an action
Example- Lipstick Sals
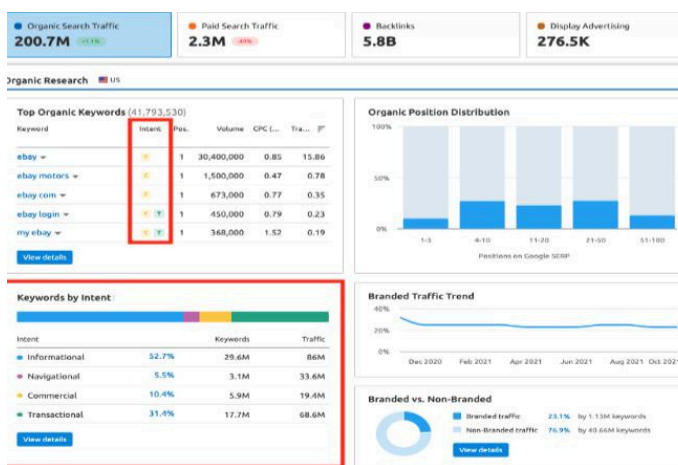
Semrush Keyword Tool Manager Overview (Keywords by Intent)

Research Objectives

Given this context, it is obvious that there are some inconsistencies in the amount of money that should be spent on SEO and/or PPC for a particular website. While some authors contend that investing in SEO is not financially prudent, others have found that people are more likely to click on organic results than PPC results. This analysis compares the competitive densities (the level of competition

between advertisers bidding on a given keyword within their PPC campaigns) and keyword difficulty (it shows you how hard it would be for a website to rank organically in Google's top 10 for the analysed keyword)

Methodology

This research project uses an empirical field/ natural experimental design. An empirical research study is a type of research methodology that makes use of verifiable evidence in order to arrive at research outcomes.
For the purpose of this research, we investigate only SEO and PPC. An experiment is conducted to compare the Competitive densities and Keyword Difficulty based on the Informational and Navigational Keywords.
The industry category selected for the research is – **Cosmetics (Beauty and Personal Care)**

Then, a significant number of trial searches were conducted to collect information. Two search queries were created for the chosen category: one was an **informational keyword** (those seeking general information or an answer to a particular question), and the other was a **navigational keyword** (people using search engines to locate a certain website or page).
Then, distinct informational queries for the category of cosmetics were entered into Google. Table 1 below shows the research results- Intent Column of the table shows the Intent of the keyword (our research is based on Informational and Navigational Keywords), Competitive Density Column of the table shows the level of competition between advertisers bidding on a given keyword within their PPC campaigns (Competitive Density is shown on the scale 0 to 1.00 with 1.00 being the most difficult to rank for), Keyword Difficulty Column shows how hard it would be for a website to rank organically in Google top 10 for the analysed keyword (The higher the percentage, harder it will be to achieve high rankings).

Table 1 Extract of results- Cosmetics (Beauty and Personal Care)

Informational Keyword- Makeup or makeup looks- "Here user wants the answer to specific questions"

Navigational Keyword- Mac makeup, makeup by Mario- "Here user wants to find a specific page or site"

Sr. No.	Keyword	Intent	Competitive Density	Keyword Difficulty
1	Makeup	Informational	1.00	95
2	Makeup looks	Informational	0.95	55
3	Mac makeup	Navigational	1.00	76
4	Makeup by Mario	Navigational	1.00	50
5	Euphoria makeup	Informational	0.84	66
6	Milk makeup	Navigational	1.00	71

Results

Only a snippet is presented here because the recorded findings take up a lot of space. For an example of the outcomes of two queries that were registered for the cosmetics segment, see Table 1.

The websites' search engine performance for informational, navigational, commercial, and transactional keywords was evaluated. In order to compare the terms based on **competitive densities and keyword difficulty**, keywords for each type of intent were placed into the **Semrush Keyword Manager Tool's search engine**.

Discussions and Conclusion

According to Table 1, the keyword "makeup" has an "Informational" intent, a 1.00 competitive density, and a 95 keyword difficulty. Therefore, based on this, we can conclude that there is no value in employing this keyword in PPC bids or organic results (SEO). By comparing the remaining keywords on an equal footing, we may draw the conclusion that, in order to receive the intended benefits, it is preferable to only bid on those that have competitive densities below 0.50 (average) and keyword difficulties below 50 (average). The data as a whole also seems to imply that for optimum website visibility, both SEO and PPC are necessary.

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The Relationship between Development, World Happiness Index and Global Antidepressant Consumption: A Comparative Study

Oshil Bansal

Abstract

Happiness and well-being are fundamental components of human life. The concept of happiness is multifaceted and is often influenced by various social, economic, and cultural factors. Happiness has been found to be influenced by a variety of factors, including genetics, environment, and personal experiences.

The counter-extreme notion of happiness is deemed to be depression. While the social nuances of the term 'depression' can range from being overworked or worried, it is scientifically defined as a mental health disorder characterized by persistently depressed mood or loss of interest in activities, causing significant impairment in daily life. A popular remedy to this disorder is the usage of 'antidepressants'.

Antidepressants are medications that are commonly used to treat depression, anxiety, and other mood disorders. While antidepressants can effectively treat these disorders, there is growing concern that they may negatively impact happiness levels. Some studies have suggested that antidepressants may reduce positive emotions like joy, happiness, and pleasure, while others have found that antidepressants may increase negative emotions, such as sadness and anger. The paradoxical research findings on the results of antidepressant use raise serious concerns over their long-term viability in ensuring well being of the population.

Currently, there is limited research on the relationship between happiness and antidepressants, particularly at the population level. This study aims to investigate the relationship between happiness index and antidepressant use in different countries.

The study first plots and analyzes the existence of a correlation between a country's happiness index and antidepressant use, if any. It further explores the factors that contribute to the relationship between happiness and antidepressant use. The findings are then applied to the popular notions of 'development' to understand the feasibility of the Happiness Index in policy-making.

This study seeks to explore the subjectivity of happiness as a development-based indicator and its appropriateness for policy formulation. The study also explores the viability of using these rankings for drafting policies because happiness and welfare can be contradictory sometimes. If the objective of such a report is to improve policies and decision-making, the entire process of report preparation should be revised to align its findings with the objective it intends to serve.

The findings of the study will have implications for policymakers and healthcare professionals in developing interventions that promote happiness and well-being in the population. The study will also highlight the need for further research on individual-level factors influencing the relationship between happiness and antidepressant use.

The World Happiness Report and Notions of Happiness

The World Happiness Report is published annually by the Sustainable Development Solutions Network, a United Nations global initiative. The report provides rankings of national happiness for countries across the globe. The United Nations General Assembly adopted resolution '65/309, Happiness: Towards a Holistic Definition of Development' in July 2011 inviting member countries to measure the current happiness levels and to use data for framing better policies.

The first-ever edition of the World Happiness Report was released on April 1, 2012, as a basic text for the UN High-Level Meeting - Well-being and Happiness: Defining a New Economic Paradigm. The second report was published in 2013, the third in 2015 and since 2016, it is being issued every year on the 20th of March, to coincide with the UN's International Day of Happiness. The report continues to gain global recognition as governments and civil society welfare organizations increasingly use happiness indicators to inform their policy-making decisions.

The rankings are largely based on respondent ratings of their own lives. The responses are also correlated and benchmarked with standard life factors. It is safe to deduce that the report is an amalgamation of quantitative and qualitative judgment.

Leading industry experts across economics, psychology, and public policy use the World Happiness Report to explain how measurements of happiness and well-being can be used effectively to assess the progress of nations. The findings of the report have been used worldwide by various welfare agencies, developmental consultancies, healthcare specialists, and many more to provide services that optimize the well-being of the population. However, happiness as a measure in itself can be contradictory to the policymakers' ultimate goal of promoting welfare. Happiness is a short-term concept and welfare is a long-term concept. The use of antidepressants for momentary happiness does not guarantee a healthy, productive life for the years to come. Spikes in happiness that are induced by factors like addictive consumption of antidepressants and drugs can lead to overestimation/underestimation of the long-term actual status of the population and can hence result in flawed policies.

Happiness, as a feeling or a notion is subjective and can assume different meanings. This study shall carefully evaluate the construction of the World Happiness Index and compare the performance of different countries with their antidepressant usage. With the increasing consumption of antidepressants across the globe, it is imperative to revisit the approach of calculating the World Happiness Index and understand if a happy population necessarily is a positive indicator of development.

Calculating Happiness Index

The World Happiness Report uses data from the Gallup World Poll. The latest report - World Happiness Report 2022 used data from the Gallup World Poll surveys from 2019 to 2021. The GWP surveys are based on answers to the quality-of-life evaluation question asked in the poll.

It asks respondents to think of a ladder, with the best possible life for them scoring a 10 and the worst possible life scoring a 0. They are then asked to rate their own current lives on a scale ranging from 0 to 10. This scale is also called the Cantril ladder. The final survey scores use the Gallup weights to make the estimates representative.

The data is procured for six factors which include levels of GDP, life expectancy, generosity, social support, freedom, and corruption. For benchmarking and comparison, data is estimated for Dystopia - a hypothetical country with values equal to the world's lowest national averages for each of the six factors.

To calculate the life expectancy score for country A, the number of years by which healthy life expectancy in country A exceeds that of the country with the lowest life expectancy (Dystopia) is calculated. It is then multiplied by the estimated coefficient for life expectancy. This product then shows the average amount by which the overall happiness score (the life evaluation) is higher in country A because life expectancy is higher than in the country with the lowest life expectancy. This process is repeated for each country and each of the six variables. Unexplained components called residuals are factored in for each country, reflecting the extent to which the six variables either over- or under-explain average life evaluations in a 95% confidence interval.

These residuals have an average value of approximately zero over the complete set

Understanding Development and Happiness

Development refers to the process of economic, social, and political change that leads to improved living standards and quality of life for individuals and societies. In the contemporary world and the 'traditional' and 'mainstream' notion of development, real GDP and per capita GDP have been used as the main indicators of a country's economic growth. However, as time has progressed, there has emerged a worldwide acceptance of the fact that economic growth in itself does not represent the correct picture of a nation's well-being. Economic activities accelerate development or are generally targeted in that direction but welfare and development constitute a host of parameters. The GDP only measures the economic output of a country and fails to consider the indirect costs of development such as inflation and unemployment. Moreover, it does not reflect essential growth indicators like knowledge and health. To address these limitations, the Human Development Index (HDI) was introduced in the 1990s, which incorporated these factors into its assessment.

HDI reports have indicated great development in the world over the past two decades in both absolute and relative terms. There has been significant improvement in indicators like Life Expectancy at birth, Real Output, and overall living standards of people across the globe. The world has also undergone a rapid wave of digitalization alongside a rise in population. This progress in development has undoubtedly led to an improvement in people's lives, but it cannot guarantee happiness. To understand this argument better, it is necessary to have a deeper understanding of what constitutes happiness.

Happiness is a state of positive emotion, satisfaction, and joy. It's a feeling that assumes different meanings for different people. Measuring it can be equated to measuring objective well-being as far as the World Happiness Report is concerned but the true picture can only be presented by accounting for the subjective well-being measures, such as domain satisfaction and quality of life.

Happiness is further open to different interpretations by different ethnic groups. For example, the notion of happiness, for an ideal Japanese person, could be a feeling of calmness whilst for an American, it could be feelings of elation and excitement. Such differences can largely be attributed to cultural differences. Given its broad scope, it is safe to state that happiness at times can be self-destructive or objectionable to a different group of people. What may account as happiness for one can take the form of a negative externality for someone else and hence, the relationship between happiness and development has been the subject of much debate in the literature. Studies have found that there is a positive relationship between happiness and development, although the direction of causality is not always clear. Some researchers argue that economic growth and development are necessary for happiness, while others suggest that happiness is a precursor to economic development.

This unclear notion of the relation between happiness and development can be understood via the concept of externalities. Policies which prioritize economic growth over other societal goals, such as reducing inequality or protecting the environment, may generate externalities that negatively affect the overall happiness and well-being of society. Economic development that relies heavily on polluting industries may generate negative externalities such as air pollution, which can harm the health and well-being of local communities. Conversely, investing in renewable energy sources can generate positive externalities such as cleaner air, improved health, and reduced greenhouse gas emissions, thereby improving the well-being of citizens. Smoking may give the smoker pleasure but contributes to air pollution. Similarly, the use of anti-depressants may make the consumer happy but is self-destructive in the long run and results in loss of productivity. A user of anti-depressants may claim to be happy but the response here shall provide a false picture of a development authority's view of happiness and welfare.

Antidepressants and the Global Consumption Trends

Antidepressants are medications that can help relieve the symptoms of depression and are used in the treatment of certain other medical conditions. They mainly fall under the following five categories: SSRIs (Selective Serotonin Reuptake Inhibitors), SNRIs (Serotonin and Noradrenaline Reuptake Inhibitors,

NASSAs (Noradrenaline and Specific Serotoninergic Antidepressants), Tricyclics, MAOIs (Monoamine Oxidase Inhibitors). These drugs work by affecting the neurotransmitters in our brains, which are chemicals that transmit signals between brain cells. Antidepressants mainly target serotonin and noradrenaline neurotransmitters. While they can be prescribed for mild depression, they are typically recommended in combination with psychotherapy for adults with severe depressive illness.

The use of antidepressants is ideally regulated by a medical professional. However, easy access to these substances in certain markets via the routes of the drug trade (often illegal) has led to un-administered consumption across the world. Moreover, stopping the use of an antidepressant can give unpleasant withdrawal symptoms which can be rectified only by consuming the substance again, essentially developing an addiction to the antidepressant.

Antidepressants are drugs classed as psychoactive substances. They enter the brain and modify normal thoughts and emotions. Recreational drugs have psychoactive properties that some people find pleasant or exciting, but other drugs like antidepressants – have psychoactive effects that are less appealing. The psychoactive effects of different antidepressants vary in strength and nature. The selective serotonin reuptake inhibitors (SSRIs) are weak and subtle whereas the effects of tricyclics are more profound.

The use of a psychoactive substance will impact the experiences and emotions captured by depression rating scales. Antidepressants come from a wide array of chemical classes and produce diverse pharmacological effects. Their consumption, whether regulated by a certified professional or recreational, triggers hormones that cause happiness and satisfaction. In such a scenario, the responses to happiness surveys may be inaccurate and overestimated. Not accounting for this factor may produce a false image of happiness. We further look at data related to antidepressant consumption in the top 24 countries. (The latest data available particularly on antidepressant consumption belongs to 2017; it was recorded and published by OECD)

Country	Antidepressant Consumption per 1,000 people	Happiness Index RankingR
United States of America	110	14
Iceland	107	03
Australia	89	09
Canada	86	07
Denmark	85	02
Sweden	79	10
Portugal	78	89
United Kingdom	71	19
Finland	70	05
Belgiun	70	70
Spain	64	34
Norway	58	01
Luxembourg	31	18
Slovania	50	62
Germany	50	16
France	50	31

Country	Antidepressant Consumption per 1,000 people	Happiness Index Ranking
Czech Republic	44	23
Netherlands	42	06
Italy	42	48
Slovak Republic	31	40
Hungary	27	75
Estonia	18	66
Chile	13	20
Korea	13	55

This data has been plotted on a scatter plot diagram which shows the relation between antidepressant consumption per 1,000 people in the top 24 countries alongside their Happiness Index Ranking.

Figure 1: The figure plots the data from Table 1 in a scatter plot diagram to study the relation between two variables.
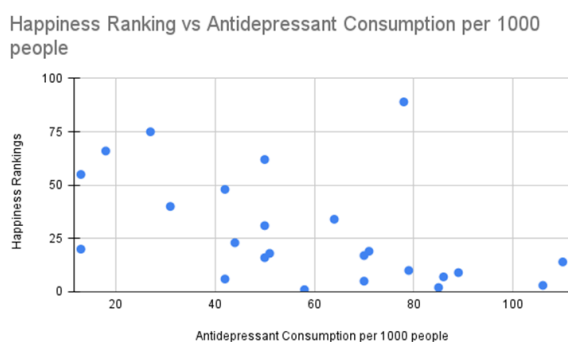
The scatter plot diagram depicts that the better (numerically lower) the happiness rank is, the higher the antidepressant consumption. There is a slight exception with Portugal as compared to the overall trend but since the dataset takes into consideration only 24 countries, it will not be fair to consider it as an exception at this stage. The diagram further shows that 1/3rd of the top 24 countries in terms of antidepressant consumption per 1,000 people are amongst the top 10 countries as per World Happiness Report 2017. Additionally, 96% of the top 24 countries in terms of antidepressant consumption per 1,000 people are amongst the top 48% countries as per the World Happiness Report 2017.

The diagram depicts how better happiness rankings are related to increased antidepressant consumption. We further analyze the causal relationship between the two variables in consideration.

As discussed earlier, antidepressants are proven to cause spikes in hormones that increase happiness and life satisfaction. This has the potential to distort the responses of the happiness surveys or the Gallop World Poll Surveys used for estimating happiness scores of countries. If that is not the case, not accounting for antidepressant consumption in the current methodology of The World Happiness Index leads to an overestimation of how happy a country truly is. There can also be a possibility of a case that since there is more awareness and less stigma around approaching medical professionals for mental health in Western countries, they tend to be happier. Either of the cases presented above can explain the causal relationship but our prime argument of The World Happiness Index being a misleading indicator of development stays true to the core.

The analysis also indicates how skewed the World Happiness Index is towards the West. As per global statistics by the OECD, antidepressant consumption is higher in Western countries. However, this does not make them happier or more progressive in the long run. Moreover, it raises serious concerns for the long-term health indicators for the West. It also has the scope of further explaining the declining productivity of labour in the Western world despite good social support programs in place and a comparatively pollution-free environment.

According to a research study conducted by Harvard, American businesses lose $81 billion every year due to loss in productivity, high turnover costs and absenteeism caused by drug abuse and addiction (Working on Addiction in the Workplace, 2017). It is mainly indicators like corruption and generosity that skew happiness rankings in the favour of The West. The subjectivity of these indicators and the availability of related objective data are further debatable. Such loopholes question the feasibility of The World Happiness Index as a true indicator of 'happiness' as well as 'development'. This assertion does not rule out the contradictory notions of happiness and development but rather, suggests that the Index in question fails to adequately present a fair judgment of any of the two.

Recommendations and Conclusion

First, it is imperative to analyze trends that are recent and standardized across a period. The availability of correct data across the world can only be regulated by the bodies that conduct the Gallop World Poll Surveys for the World Happiness Index Rankings. The data collected needs further slicing into the consumption of different classes of antidepressants to estimate the true long-term impacts on health and welfare.

Second, the reports like the World Happiness Report need to establish the notion in which they see happiness to be an indicator of development because, often, the notion of these two terms is contradictory in nature and can produce misleading results.

Third, the methodology used to estimate happiness scores in the World Happiness Index needs to be revised because it fails to account for important factors like antidepressant consumption and unemployment, to name a few.

Fourth, the objective and application of the World Happiness Index need to be realigned. Currently, it serves the purpose of a large number of economists, researchers, NGOs, and Governments to estimate welfare and development. However, the population's happiness cannot always present a fair picture of growth. This in turn leads to research and policy frameworks that are built on misguided indices and fiduciary judgment.

Fifth, the subjectivity involved in the collection of data for calculating objective indices needs to be eliminated. The 6 indicators used in the Gallop World Poll Surveys should be redefined to reduce personal bias.

The research conducted is not an attempt to disregard the viability of The World Happiness Index. Its guiding principles are of the utmost value for meticulous policy formulation in the present times. This study is just an attempt to point out the fallacies of the report given the different consumer behaviours and lifestyle trends across the globe. Since indices also present the relative progress of nations on various indicators, it is essential that the approach followed is a level playing field and carefully guides towards the established objectives.

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Why India Cannot Get the Black Money Back

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Introduction

A few years after retiring from the IMF, I applied for the position of Lead Economist at Global Financial Integrity (GFI), then a fledgling think tank in Washington-DC, founded by Raymond Baker. During the interview, Raymond questioned my ability to estimate the volume of illicit funds (or black money) coming out of developing countries and where they are going. I replied that while I was fairly confident about estimating the first part, I was rather uncertain about achieving the second. That was probably the first time someone got a job and said they couldn't do it!

Using economic models of capital flight and illicit flows due to trade mis-invoicing, studies at GFI estimated that developing countries were losing at least US$1 trillion annually. Subsequently, a 2010 study at GFI estimated that India had lost around US$500 billion between 1948 and 2008, which was stashed in international banks and tax havens around the world, prompting the Government of India to publish its own report. [2]

It should be noted that the $500 billion belonged to the Indian private sector. The public sector or the government does not hold black money—only private individuals and corporations do. In other words, the government does not steal from itself.

This was such a stupendous amount that its return became a political issue in the run-up to the 2014 General Elections. Baba Ramdev contacted me, wanting to know how India might recover the black money. Politicians were not waiting for answers, with campaign speeches promising to bring the money back. Meanwhile, I explained to Baba Ramdev why India could not do so. Reasons were tied to the nature of black money and the international financial system.

Nature of Black Money

Firstly, the question of whether the funds deposited abroad are black (illegal) or white (legal) can only be determined by a court of law having jurisdiction to hear the case. Even banks and tax havens have no idea about the extent of black money they hold. In their defence, bank officials say that banks are not investigative agencies, but financial intermediaries.

While governments have compelled banks to collect basic information about their clients through know Your Customer or KYC, these requirements are not enough to tie the deposits to their true owners, known as "ultimate beneficiaries". Presently, on-shore banks or those in tax havens are not required to establish beneficial ownership that can identify the actual owners of those deposits. So, depositors can hide their identities behind anonymous shell companies, trusts, and complex financial instruments (e.g., derivatives) where establishing the ultimate beneficiary is almost impossible.

In fact, the Panama Papers (see below) revealed how private companies, politicians, high public officials, and the wealthy hide their ownership of funds. Even the managers of "brass-plate" companies and trusts based in tax havens like the British Virgin Islands and the Cayman Islands have no idea who they are working for. In other words, there is zero information about the actual people who own these companies, which only exist on a brass plate in some buildings in

a tax haven. Of course, some legal document somewhere has this information, but it is not in the public domain.

Secondly, even the Government of India cannot declare an Indian citizen's deposits abroad illegal without a judgment by an Indian court to that effect. Then, the court of law in the country, where funds are deposited also has to agree that the bank knowingly took the illegal deposits. Establishing illegality in both jurisdictions is an uphill legal task, particularly with the passage of time.

Nature of the international financial system

Finally, economists know precious little about where black money goes after it leaves a country except that it could either be deposited in the banks of advanced countries or in tax havens. Both can be linked to black holes—destinations that do not provide any meaningful information on the total value of assets by type and maturity, country of residency of depositors, sectoral breakdown of deposit liabilities, etc.

Even if you manage to get in touch with these black holes, the answers to your questions would be evasive.Their skimpy "publications" tend to raise more questions than they answer. Literally, these black holes have zero luminosity. That refers to the illumination of knowledge. In fact, the word "transparency" is alien to the people running that world.

No wonder that tax havens, and even many advanced countries like Singapore, Switzerland, the United Kingdom, and the United States are known as "secrecy jurisdictions". Moreover, as offshore banks in tax havens often have their headquarters in advanced countries, there are strong financial linkages between the two jurisdictions.

Business has been so good for tax havens that their assets and liabilities have grown exponentially. Assets are what tax havens invest abroad while their liabilities consist of deposits by foreigners. Even the

world's most powerful investigative agencies like the CIA, the FBI, the Interpol, and Scotland Yard, have few clues about who holds what and how much in these tax havens. Some of them like the Cayman Islands grew so much in the dark that they went bust. The United Kingdom had to bail them out. However, not all tax havens are under the jurisdiction of an advanced country and when these go belly up (like Cyprus), you are out of luck.

The Panama Papers

One day in 2014, "John Doe", an anonymous person called Bastian Obermayer, a reporter working for *Süddeutsche Zeitung*, a German newspaper. John said he wanted to talk about some highly sensitive data, but that his life was in danger. There is no way he is going to give Obermayer a personal interview but suggested that they chat using encrypted files. Is Obermayer interested in what he has to say? Naturally, this pricked the reporter's ears. Still, he asked John why he wanted to spill the beans.

John said he wanted to "make these crimes public." He was seriously concerned about the growing income disparity between the rich and the poor, and the widespread corruption in many countries. He was angry about the injustice meted out by firms like Mossack Fonseca, which helped the rich hide their money in tax havens and evade taxes. Shortly thereafter, he began transferring about 11.5 million documents from the law firm Mossack Fonseca, based in Panama[3].

Süddeutsche Zeitung verified that the documents were authentic and shared them with the International Consortium of Investigative Journalists (ICIJ) as well as The Guardian and the BBC. They finally released the documents to the public, which became famous as the Panama Papers. What were the main findings and consequences of these documents?

The Panama Papers revealed that the rich and famous tend to take advantage of tax havens or offshore financial centres to avoid paying their fair share of taxes. The documents show the extent to which law firms like Mossack Fonseca, accountants,

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[3] *Wikipedia White Paper on Black Money, Department of Revenue, Ministry of Finance, Government of India, May, 2012.*

and investment advisers help the rich hide their wealth from tax authorities for an annual fee. Such companies are run on a worldwide basis. They have specialized knowledge of the tax havens and the rates of interest offered on the various types of investments, etc. Generally, these tax havens charge little or no taxes on these investments, which are maintained in total secrecy with little regulatory oversight.

It came to light that 143 politicians (including 12 national leaders and their friends and relatives) as well as thousands of the rich and famous around the world have deposited their funds in tax havens. While it is true that having a deposit in a tax haven is not necessarily illegal, the public revelation of these depositors reflected poorly on their honesty and integrity.

A second set of 1.2 million documents related to the Panama Papers revealed the names of at least 12,000 Indians, including the CEOs of several companies, some lower-level politicians, iconic Bollywood celebrities, and a few individuals connected to the underworld. However, as far as we know, the evidence was not enough to send any Indian to jail for tax evasion or money laundering.

Mossack Fonseca is only one among hundreds, thousands, of such law firms, operating globally, helping to hide the assets of the rich from the tax authorities. In fact, Panama is a relatively small tax haven compared to others like the Cayman Islands, Hong Kong, Singapore, and Switzerland (when ranked by the volume of offshore deposits). Furthermore, there are law firms with a much larger global footprint and assets under management than Mossack Fonseca. The Panama Papers barely scratched the surface of the global stash of black money.

Can India get back the black money orbiting in black holes?

There was considerable interest in the Indian media in whether India could ever get back the hundreds of billions of dollars[4] in black money it has lost to these black holes since independence. I told them not to

hold their breath. In one of his calls with me, Baba Ramdev tried to float a particularly bizarre idea, he said, "The Government of India can simply declare that all the black money of Indian citizens deposited in foreign accounts belongs to the Government of India." He was talking about confiscating illegal funds.

I said, "Please go right ahead. Why only make one declaration? Make a hundred declarations that the black money in foreign accounts belongs to the Government of India. It will make no difference." Illegality has to be proved in court first. The following hypothetical case illustrates the difficulty.

Suppose that on June 8, 2018, the Government of India filed a case in the Delhi High Court (which is the competent court to hear the case) that Mr. X, an official in the Ministry of Mines, received a bribe of Rs.10 crores on or about September 12, 1978, from Mr. Y, CEO of TT Mines and Minerals, which was then transferred out of India on September 21, 1978.Just establishing these basic facts (called prima facie evidence) is likely to present a huge challenge to the Government of India.

Then, the government has to bring both Mr. X and Mr. Y to court and place all the admissible evidence that Y gave X the bribe on or about September 12, 1978. Prosecutors have to prove that Mr. Y received a specific favour in exchange for that bribe (for example, X awarded the contract to Y). There has to be a quid pro quo because nobody pays a bribe for nothing in exchange.

There could be complications if one or both parties involved in the case are deceased, but let us assume for the moment that they were still alive and well enough to come to court. Just imagine trying to present hard evidence before a judge that Mr. X did receive the bribe from Mr. Y some forty years ago.

Even if the evidence is presented, the judge may well ask the government lawyer, "What were you doing all this time?" Supposedly the lawyer says, "We were trying to collect all the evidence", absurd as it may sound. Then, Mr. Y says, "Where is the evidence that I paid him?" In a country where the courts take thirty

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[4] See, for example, *Getting black money back is a myth*, Business Standard, January 25, 2013, first published February 15, 2011.

years to restore a property to its rightful owner, how long do you think it will take for the court to establish that Mr. X took the bribe from Mr. Y some forty years ago?

Now, even if the Delhi High Court renders a judgment that Mr. X did receive the bribe from Y, tracing the money is impossible. It is like trying to convict a murderer without a murder weapon or a body! The defence lawyer can corner the prosecutor along these lines: "Show me the money! Where is the money? If the Government cannot provide any evidence on where that bribe money is, then what are we talking about?"

In this electronic age of moving funds, it would take seconds to move the money from Switzerland (where the equivalent of 10 crores was originally deposited). For instance, Mr X could have already split and shifted the funds into a shell company with an account in a bank in the Cayman Islands as well as a portion of the proceeds into a massive hedge fund based in New York. Both of them are excellent black holes.

So, the case falls flat because the Government could not trace that bribe to a specific account held by Mr X in either Cayman Island or sloshing around in a mega hedge fund. Mr X had done his homework and made sure from day one that any black money he held abroad could never be traced to him!

It should also be noted that international agreements like the Double Tax Avoidance Agreement (DTAA) have a "no fishing expedition" clause. The clause says that a country cannot use the DTAA to go after "black money" in a blanket fashion. The "no fishing expedition" clause in turn arises from the "innocent until proven guilty" clause and strong privacy laws in advanced countries. The Government of India has to present the judgment of an Indian court that it found sufficient evidence of wrongdoing in connection with a specific transfer of black money. Otherwise, Switzerland would not consider the government's request valid under the exchange of information clause.

Now, even if the government could present prima facie evidence, the fact remains that the specific

transfer of black money from India into Switzerland must have taken place after the DTAA between the two countries was signed. In that case, Switzerland would start to look for the funds belonging to Mr X.

But, as we have already pointed out, Mr X made sure that the black money he held could never be traced back to him.

In fact, Mr X's hard-earned bribe is working overtime as a small part of a $500 million derivative held in the name of some obscure company. Both the shell company in the Cayman Islands and the company in New York managing the derivative have no information whatsoever that it is really Mr X who is the beneficial owner of the funds. The utter lack of information on beneficial ownership is a primary feature of the world's financial system. Good luck trying to find Mr X's bribe in those black holes.

Now, this is just the case of Mr X's bribe, which was paid on a certain date for a favour done on a certain project. There are thousands, if not millions, of such cases that make up nearly five hundred billion dollars (at present value). And each of these cases presents its own daunting legal challenge to first, prove guilt and, second, trace the proceeds to the accused black money holder. How long will the Government of India take to get all the black money back? Forever, is one word. Eternity is another.

Conclusion

No wonder efforts to date by various countries and international organizations to bring back black money have been very disappointing. For instance, the World Bank's Stolen Asset Recovery (StAR) initiative has been able to bring back only a minuscule fraction of the total volume of illicit assets that have been spirited away from poor developing countries over the past several decades. Despite the significant resources of the World Bank in terms of funding, staff, country legal expertise, and the political backing of member governments, the StAR initiative has thus far managed to retrieve only about $1 billion since its inception in 2007, compared to the trillions stolen from all countries.

The eventual return of black money may be possible in a limited number of cases where the transfer of

funds was very recent or if investigative agencies were already hot on the trail of the culprit, such as in the case of Vijay Mallya or Nirav Modi. Even then, it may take years before the government gets its hands on any stolen funds, and the net amount realized is likely to be a fraction of what the culprit stole (after paying exorbitant fees to both Indian and foreign lawyers).

Stopping the flow of black money from India requires a two-prong strategy. While India needs to strengthen governance at home, it must push developed countries against taking in tainted funds. They need to do a better job of getting information on these depositors. Strong governance, including establishing the rule of law, is imperative to stem the leakage of black money. If governance and enforcement loopholes are not closed, an emphasis on getting the money back is meaningless. Even if the money were to return, it would leak out again. It's like pouring water into a bucket full of holes.

Greater efforts should be made to reign in tax evasion by improving the capacity of India's tax authority. In fact, most developing countries do not have enough tax officials to collect taxes. For example, whereas Kenya and Nigeria employ 3,000 and 5,000 tax and customs officials for populations of 32 and 140 million, respectively, the Netherlands employs 30,000 tax and customs officials for a population of 10 million.

Therefore, in order for a country to effectively collect taxes and follow up on suspected cases of tax evasion, it is imperative that it gradually shore up its staffing and training of tax officials. In addition, India needs to enter into various agreements to exchange information with developed countries. Securing the barn door firmly is a lot better strategy than chasing the horse after it has already bolted from the farm.

Making Invisible Visible
Nature's Economy

Dr Rajendra Shende
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There are estimated 8 billion species of animals on our planet. Human, one of those 8 billion species, is distinguished from other animals by very distinct attributes. *One of the early attributes is that human is the only animal that laughs when happy! The latest attribute is that it is the only animal on our planet that can write an algorithm and apply Artificial Intelligence for its benefit.*

I read somewhere about yet another distinct character, that human is the only specie that gives tips or awards to other humans for providing good and services. I want to propose yet another attribute: humans are the only species that take enormous life-long and life-enriching free services from nature but never provide tips and awards to nature, instead it punishes the nature on which they survive. No patent fees are given to nature from where humans get ideas. All the materials, devices and so-called 'invented' machines are basically made from nature directly or indirectly. Nature provides the raw materials which are processed by the mechanisms that use natural materials. Some ideas like aeroplanes and ships are even copied (birds and fish) from nature's lab that has existed for 4 billion years. However, the so-called 'advanced economics of the modern world' has remained totally alienated from the economics of nature.

Today's global challenges, be it loss of biodiversity, dreadful climate change, severe air pollution and even pandemic are the result of the total lack of our understanding of the 'green economy' that has remained invisible even to Nobel Prize winners in economics that invent the theories like empirical contributions to labour economics and research on banks and financial crises! Nature -economics and nature-crisis remain dormant deep in the soil or in the stratosphere of the planet.

United Nations Environment Programme has defined a green economy as low-carbon, resource-efficient and socially inclusive. Indeed, green economy is all that. But Green Economy goes beyond all that. In today's economy, we all respect money. Money matters. In a green economy, it is necessary that we respect nature. Nature matters.

Focusing on growth of GDP, growth in employment, growth in profits and growth in public and private investment for manufacturing, services and infrastructure and growth in creating related assets, is the way of today's economy. They may be the indicators of a healthy economy. However, the indicators that internalize the intrinsic value of nature's ecoservices for integrated and holistic development have remained grossly neglected.

"Ecosystem services" provided by nature to humanity have not been understood and hence overlooked. For the public, ecoservices are limited to the images of serene and lush-green mountains, pristine water streams, sunsets over oceans and lucid waves viewed from the beach. However, no one considers the action needed when it comes to deforestation, water pollution, plastic in oceans and air pollution over the beaches. An increasing number of experts from scientific and economic communities say that putting real economic value on components of nature that feed into our production and consumption patterns will help protect the environment and enhance biodiversity. That exercise of valuing the ecoservices would trigger sustainable solutions to our global challenges like climate change and loss of biodiversity.

As against taking nature for granted, if one adopts the principle of measuring the unmeasured and valuing the "natural capital", it can offer a way to assess the fundamental benefit that humans derive from nature. Ascertaining that value can then help decision-makers bring environmental factors more

explicitly into their planning. That could be the starting point to focus on 'Green Domestic Power'-GDP rather than 'Gross Domestic Product'. That could prove to be the start of the green economy.

The concept of Sustainable Consumption and Production -SCP-aims to reduce resource consumption, waste generation and emissions across the full life cycle of processes and products. Resource Efficiency points to the ways in which resources are used to deliver value to society for their well-being. Resource efficiency also aims to reduce the number of resources needed, and emissions and waste generated, per unit of product or service. The Green Economy provides such indices and a macroeconomic approach to sustainable economic growth. The central focus of course would be on investments, employment and skills based on Environment- Social- Governance (ESG).

Measuring to manage is the general mantra but it is hardly used for measuring and managing Natural Capital and resource efficiency. Can biodiversity loss, then, be seen as an erosion of the living-nature capital market? Loss of tree cover leads to loss of biodiversity, the way in the present economic concepts, loss of assets leads to erosion of capital. Presently, the economic value attached to nature is zero. Our metrics are geared toward the consumption and production of man-made goods and services, and we tend to gloss over nature. This has led to 'bad accounting' or rather 'wrong accounting' which, in turn, has contributed to rapid biodiversity loss.

The forests on our planet cover 30% of the land surface. They are valuable resources that store massive amounts of carbon, purify water and air, enhance biodiversity, and importantly provide livelihoods for millions of people. However, the forests equivalent to 30 soccer fields are disappearing every minute. The simple reason is the economic loss due to such deforestation has not been measured before its disappearance and the disaster.

The estimated total value of the world's forests is as much as $150 trillion—nearly double the value of global stock markets. It is forecast that there will be a 30 per cent loss of this capital by 2050 if we do not conserve them.

Present market mechanisms fail to reflect the alarming erosion of the natural capital from which these vital benefits flow. Loss of forests for agriculture, human development or wildfires resulting from climate change is in fact not only weakening human well-being but also the nature's balance based on biodiversity.

Losses in the U.S. financial sector in the economic downturn between $1 and $1.5 trillion make headlines. But the news on the loss of forests worldwide which amount to trillions per year gets submerged. It is an ironic perception of humanity that is heading for disaster. According to research cited by UNEP, an annual investment of $45 billion to biodiversity conservation worldwide could safeguard about $5 trillion in ecosystem services — a benefit-to-cost ratio of 100 to 1. FAO estimates that out of 100 crops that produce 90 per cent of the world's food, 71 are bee-pollinated. 4000 vegetable varieties are pollinated by bees.

Honeybees in America produce food equivalent to nearly 2 USD billion per year. The benefits of all the eco-pollinators in the USA contribute to about USD 4 to 6 billion per year. Large hives of bees are getting destabilized by the use of chemical pesticides on nearby crops. All the eco-pollinators in the USA contribute about USD 4 to 6 billion per year.

Just about 400 years back, in the history of 200,000 years of the existence of modern man, we swallowed the bitter truth that Earth is not the centre of the universe. The whole idea that we are not at the centre was so repulsive that we almost killed all those who proposed it, even if the science was on their side.

Then we rejected the idea of nature capital, then afterwards in case of ozone layer depletion and then in case of climate change. That has delayed global actions to address the challenges. Humanity's deniability and disability to connect these global challenges to the state of nature coupled with the perception that nature's resources are free are the fundamental reasons for the present-day global challenges.

When we internalize the ecoservices from nature in our accounting system, we will realize that the costs of

maintaining the integrity of ecosystems and conserving it are small as compared to their benefits. That further strengthens the concept that unless we measure the benefits and losses, we cannot manage them. The economic value of ecoservices, for example, the value of services offered by forests, mangroves and bees needs to be researched and pinned down using digital techniques. Often such values are determined after its loss. By then the opportunity to protect ecoservice has gone.

What we need is to institutionalize the research, policy, modelling and experiments for managing natural capital and the green economy because of its "public good" aspects. For example, there are systems of payments for ecosystem services, such as compensating farmers who plant trees for carbon sequestration. These could be embedded in common asset trusts, set up to assign property rights to the community rather than private hands. Those who damage ecosystem services would be charged, while those whose land produces services could be paid.

It is crucial that we do not miss the opportunity to maximize the economic opportunities that climate change action can create. Countries that have taken ambitious goals and measures to reduce carbon emissions and develop a renewable energy industry in response to climate change can today benefit from new dynamic sectors that generate significant economic gains and employment opportunities.

In Germany, it is estimated that by 2020, renewable energies will generate more jobs than the country's automobile industry. And, as illustrated above, the green economy also presents opportunities for developing countries. Going forward, the international community must focus and act, on the benefits of climate change action. We also need to ensure that these benefits are available to all. Today's climate finance can link assistance to developing countries through green economic policies.

While there are ongoing dotted projects and research works in Government and Universities on Green Economy, what's different now is the urgency. We need various institutions for managing natural capital because of its "public good" aspects. For example, there are systems of payments for ecosystem services, such as compensating farmers who plant trees for carbon sequestration. These could be embedded in common asset trusts, set up to assign property rights to the community rather than private hands. Those who damage ecosystem services would be charged, while those whose land produces services could be paid. Economic incentives can encourage people to preserve natural assets.

For example, in Costa Rica- now called as Nature-Super Power- pharmaceutical companies are paying landowners to conserve their properties - essentially maintaining a genetic laboratory in an area with great natural wealth. (About half of the manufactured drugs derive from materials found in nature.) Costa Rica has been a laboratory in strategies for making money while saving the environment.

The renewed interest in valuing nature gives us the unique opportunity to show that the economic value of ecoservices is Not zero, this gives policymakers a vehicle for addressing our fragile ecosystems to make it Net Zero.

Power Distribution and Impacts on Agrifoods Systems

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Abstract

Global agrifood systems are facing various uncertainties, which have never happened in the past. Besides persistent poverty, quick urbanization and degradation of natural resources; political crises, conflicts and market concentration have led to an increase in existing inequalities that hamper systemic sustainability and resilience. This paper discusses power distribution and the impacts of the domains of geopolitics, market concentration and country interdependencies.

Trends and Impacts

Political Power and Geopolitical Instability

Geopolitics analyses how political power in geographical regions is distributed, how stable relationships among countries are, and how each country maintains its national autonomy capacity to shape its political and economic environment. Geopolitical instability is recently rising and is caused by risks associated with countries' tensions and actions that affect the peaceful course. Violent conflicts are considered as geopolitical instability.[1]

Recent geopolitical trends[2] include:
1) a crisis of multilateralism where a multipolar is increasing with a more limited role for international institutions;
2) the prevalence of conflicts has become more frequent and complex, involving more actors[3];
3) forced displacement continues to rise[4];
4) political violence is rising in multiple forms;

3) global military expenditure is increasing;
6) conflict over water can trigger violence or be used as a weapon of conflict;
7) climate change poses additional risks through migrations and;
8) the shift of the balance of power is moving from the West to the East.

There are direct linkages between hunger and peace. A vicious cycle of instability exists where food insecurity, both results from and contributes to repeated rounds of armed conflict. The 'geopolitically motivated food disruptions'[5] pose higher risks to all core functions of agrifood systems (production, processing, distribution and consumption), notably: shortfalls in production and trade, price increases coupled with lower incomes and purchasing capacity, rising inequalities, reduced labour supply, undernourishment, deliberately-induced hunger and famine-related deaths. In the longer term, conflicts have significant and lasting impacts on food security by compromising agriculturally based livelihoods, food production, trade and access.

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[1] *Food and Agriculture Organisation of the United Nations (FAO), The Future of Food and Agriculture: Drivers and Triggers for Transformation, December 2022 (FOFA 2022).*

[2] *Julius, J. 2022, Geopolitical instability and increasing impact of conflicts. (FAO's internal Working Paper)*

[3] *Cilliers, J. 2015. Future (im)perfect? Mapping conflict, violence and extremism in Africa. ISS Paper, 287, October 2015. Institute for Security Studies. Pretoria, South Africa.*

[4] *Internal Displacement Monitoring Centre, Global Report on Internal Displacement 2020.*

[5] *World Economic Forum (WEF), The Global Risks Report 2019, (WEF: Geneva, 2019), p. 69.*

Market Power and Market Concentration

Market concentration is the degree to which a small number of companies control a large part of a market. Globalisation boosted international trade and the expansion of global value chains (GVCs) has fueled the concentration of entire large segments in the hands of relatively few transnational companies.[6] Concentration has taken place horizontally through mergers and acquisitions among firms operating at a particular stage of food value chains - largely propelled by economies of scale, generating a greater market power. Strict food safety requirements of importing countries, in addition, are likely to push up vertical concentration progressives. Vertical concentration gradually emerged along GVCs while maintaining production standards governed by a leading firm.

There are some current trends as concentration in agricultural inputs. By 2020, the four top agrochemical firms (ChemChina/Syngenta, Bayer, Corteva and BASF) weighed 65% of the market (Hendrickson et al., 2020). Concentration in agricultural production is higher in high-income countries while a large mass of increasingly fragmented family farms coexists with giant farms in LMICs(Low and middle-income countries) (FAO, FOFA 2022). Global bulk commodity trade has been dominated by a few large transnational companies that operate at almost all stages of GVCs (Murphy et al., 2012). Retail markets are the most concentrated segment.

Market concentration could be seen as harmful to growth, food security, nutrition purposes, and the overall sustainability of food systems. This concentration could create monopoly power, harming both farmers and consumers. As there is more concentration, more smallholders will be excluded. At a certain level, large corporations will accumulate sufficient knowledge and information to be in a position to decide and impose what consumers will eat in the future (GRAIN and Biothai, 2018).

Cross-country Interdependencies and Food Commodity Dependences

Increasing geopolitical instability and market concentration pave the way to increased cross-country interdependencies. Political and economic domains comprising, for example, exchanges of goods and services, including capital goods and transport, financial flows of borrowing- lending and investing, technical knowledge flows, geopolitical influence, security and military relationships, etc. are shaping new global integration and are directly impacting agrifood systems.[7] The participation of countries in GVCs through commercial relationships with external partners is getting inserted into the global economy.

The high-income countries (HIC) keep a bigger market portion of global agrifood and financial markets. HIC and transnational lead firms are the most powerful actors to set the rules in global markets. Low and middle-income countries (LMIC) may barely benefit from entering international markets. In addition, current food prices have not fully covered environmental and social costs that put LMICs who are agricultural exporters, facing serious challenges in terms of sustainability and resilience.

Food commodity dependence of a country occurs when it exhibits large shares of commodities in imports and/or exports.[5] Commodity dependence, both from the export or the import side, makes a country's socio-economic system more vulnerable, less resilient to shocks and more prone to hunger and malnutrition.[6] Countries having agriculture-dominated economies tend to be scored as higher risk. The proportion of countries with a higher risk score rises with the share of agricultural value added within three country groupings: those where agriculture constitutes less than 10% of the GDP, those where agriculture is between 10% and 25%, and those where agriculture exceeds 25% of the GDP (FOFA 2022).

Future Scenarios

The UK Ministry of Defence used two variables - distribution of power and level of cooperation to

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[6] *MoraisDeSousa, P. 2019, Market concentration in food and agriculture. (FAO's internal working paper: Critical and Emerging Issues n.3).*

[7] *Benedict, E. K. 2021. Cross-country interdependencies. (FAO internal Working paper contributes to The Future of food and agriculture). Swedish Environmental Institute.*

create four future worlds: fragmentation, multipolarity, multilateralism and network of actors. FAO adopted its assumptions to develop alternative futures of agrifood systems: race to the bottom, more of the same, adjusted future and trading off for sustainability (FOFA 2022).

Figure: Future worlds – distribution of power vs cooperation
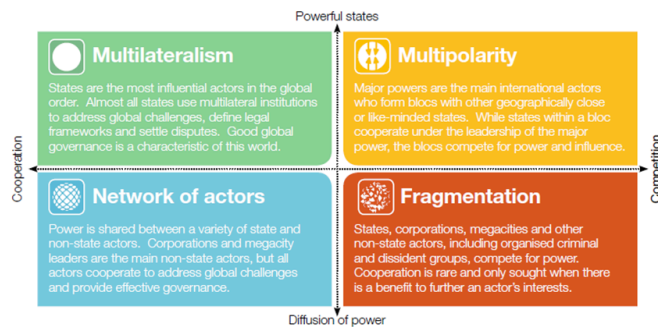
Source: HM Government, Ministry of Defence op. cit.

Scenario 1 - Fragmentation Emerges Race to the Bottom

Substantial parts of agrifood systems collapsed. There was increased fragmentation and self-interest globally. Societies are structured in separate layers with self-protected elite classes. A series of consecutive economic crises exacerbated inequalities and widespread poverty fuelled instability, civil wars and international conflicts. Famine, forced mass displacements, degradation of natural resources, loss of biodiversity and ecosystems' functions, and the emergence of new pandemics, as well as nuclear and bacteriological contamination, were just signs of a world in complete disarray.

Scenario 2 - Deterioration, Multipolarity Gains Strength – More of the Same

If most trends and trajectories continued,[8] there would be a world of competing great powers and competing blocs. Ineffective development strategies and policies, economic imbalances across and within countries and skewed international trade, including persisting commodity dependency of many LICs, resulted in

national and geopolitical grievances, deteriorating social and humanitarian outcomes. Agrifood systems kept struggling to satisfy an increased food demand and faced further degradation and high risks of systemic failures.

Scenario 3 - Slight Improvement, Multilateralism Strengthens – Adjusted Future

The security context reflects the cooperative nature of multilateralism. Governments engage in multilateral agreements aimed at addressing issues that required global governance, such as mass migrations and blatant inequalities, tried to tackle the most urgent trade-offs and adopted fiscal policies to fund social protection measures. Multilateral institutions become empowered to deal with global issues. Agrifood systems at large could achieve short-term benefits from such interventions.

Scenario 4: Network of actors - Trading off for sustainability

New power relationships have shifted the development paradigm in most countries. Distributed and participatory power and governance models gradually took over and complimented, or partially replaced, other power relationships based either on typical autocratic governments or on the enormous influence of big transnational companies. GDP growth was traded off for inclusiveness, resilience and sustainability with a significant reduction of hunger and instabilities.

Possible Policy Options

Developing risk management strategies to contribute to reducing multiple risks and mitigating their impact.

The world remains full of risks and uncertainties; it is more and more difficult to be optimistic about the future. Risk management strategies with early-warning systems and emergency preparedness can contribute to building resilience capacities so that agrifood systems can be better positioned to prevent, anticipate, absorb, adapt and transform in response to shocks, stresses and stressors, including

[8] *NATO. 2020. NATO 2030: United for a New Era. Analysis and Recommendations of the Reflection Group Appointed by the NATO Secretary General.*

geopolitical instability.

Food security and fair pricing depend on markets that are free from monopolistic tendencies. Political considerations are therefore crucial to understand how agricultural and food policies are determined, and to identify the constraints addressing the competition policies in food and agricultural markets.

More systematic approach and stronger actions to strengthen the global political security.

Inclusive decision-making is fundamental to sustain peace at all levels, as are long-term policies to address economic, social and political aspirations. Stress the importance of working together in a multilateral system and the cost-benefit associated with that. States are increasingly required to work with each other and with other actors to keep their countries on a pathway to peace. Preventing violence requires seeking inclusive solutions through dialogue, adapting macroeconomic policies, institutional reforms in core state functions, and redistributive policies.

Self-Interest and the Promise of a Market Economy:
What Can Adam Smith Still Teach Us?

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Introduction: The Critique of Economic Science

This essay has been provoked by a recent presentation by the applied mathematician and scientist, Professor Gael Giraud at the Math-Stat Colloquium Spring 2022 series at American University.[1] I was requested to present a rebuttal to the Giraud presentation that had offered what some would see as a devastating critique of economics science as shaped by the legacy of Adam Smith. This essay builds on an initial rebuttal that was done jointly with my colleague, Professor Yong Yoon.[2]

The Giraud critique has been propagated by non-cooperative game-theoretic constructs - populated by so-called *selfish agents* - that seek to prove the theoretical impossibility of finding unique, stable, and Pareto-optimal outcomes. Such results are then argued to disprove Smithean insights into the workings of self-interested behaviour and the *invisible hand* in obtaining a competitive market equilibrium that would meet the welfare criteria of Pareto optimality. In addition, the Giraud critique revives the older heterodox traditions that embraced a more radical, ideological critique of markets inspired by Marx, and formalised later by Sraffa and the mid-20th century Cambridge theorists.[4] Taken together, these critiques suggest an inherently unstable, inefficient, and exploitative nature of market institutions.

Economics, as a science, in the 21st century seems to have reached a difficult impasse. On one hand, it is expected to meet significant policy challenges that demand attention by the profession – including climate change; the possibility of continuing, and new, pandemics; instability of global and domestic markets; rising inequality; and the rise of economic nationalism in the face of external threats. At the same time, the building blocks of our science - of self-interested human behaviour, along with key normative, welfare predictions premised on the workings of a market-based economy are being increasingly questioned by both economists and non-economists. What to do?

In this article, I focus on the non-ideological source of the critique that is based on game theoretic outcomes to make two broad arguments: one, the general lack of practical-empirical significance tied to these results; and two, their lack of theoretical robustness in light of steep information requirements imposed on real-world agents attempting to reenact the behaviour of selfish, or altruistic, agents posited within these games. Next, I argue that far better predictions of real-world market interactions follow if we apply insights from Adam Smith. Doing so requires that we distinguish between the behaviour of selfish agents that populate the non-cooperative games modelled by

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[1] Giraud, Gael (2022) *"Some Applications of Mathematics in Economics"* presented at the Math-Stat Colloquium Spring 2022 Series at American University Washington, DC: March 22.

[2] Mehta, Nimai and Yoon, Yong (2022) *"Meta-Mathematics and Meta-Economics: In Defense of Adam Smith and the Invisible Hand"* presented at the Math-Stat Colloquium Spring 2022 Series at American University Washington, DC: April 21.

[3] See also Giraud, Gael (2003) *"Strategic Market Games: An Introduction"*, Journal of Mathematical Economics. Volume 39, Issues 5-6: 355-375; Fisher, Franklin M. (1989) *"Games Economists Play: A Noncooperative View"*, The Rand Journal of Economics. Volume: 20-1: 113-124; Nash, John Jr. (1996) *"Non-Cooperative Games"* in Nash, John Jr. (1996) Essays on Game Theory. Edward Elgar Publishing, Inc.: Massachusetts.

[4] See Sen, Amartya (2003) *"Sraffa, Wittgenstein, and Gramsci,"* Journal of Economic Literature, Vol. XLI: 1240-1255..

Giraud, and the psychology of self-interested agents that Smith observed to be the basis of exchange in the real world. The information requirements for self-interested behaviour turn out to be far lower relative to those faced by selfish agents operating within a market economy. In addition, the information requirements for altruistic behaviour remain high, if not higher, than what both self-interested and selfish agents face in real markets. Furthermore, the existence of a market dramatically reduces the information cost for self-interested behaviour while increasing both selfish and altruistic agents. Finally, I consider the *propensity to trade* that Smith understood to be a uniquely human trait. Its significance, I suggest, lies in reducing the necessity of a cooperative solution for the emergence of markets and the consummation of trade.

Non-Cooperative Games with Selfish Agents: Their Lack of Practical Significance

A selfish agent is defined in terms of behaviour posited in response to a given structure of game payoffs. Each agent within the game acts to appropriate the maximum surplus for themselves, leaving the other agents indifferent between playing versus not playing the game. *Giraud (2022)* provides the following two examples of non-cooperative games with selfish agents that generate instability, multiple and non-Pareto equilibria.

A \ B	C	NC
C	5,5	2,8
NC	8,2	0,0

Game # 1

Game #1 illustrates the instability expected, with each selfish agent seeking to outdo the other; Game # 2 instead illustrates a non-cooperative equilibrium which leaves both players indifferent between exiting versus staying in the game. Such results, flowing from

A \ B	L	R
L	1,-1	-1,1
R	-1,1	1,-1

Game # 2

the internal logic of games and as played by selfish agents, imply that the exchange between the buyer and seller is unlikely to be consummated. Or a stable market fails to emerge.

What should one make of these results? Contrary to the dire predictions on both the feasibility and fairness of trade, we do observe that trade is constantly being consummated between individuals acting in their respective self-interest, new markets keep emerging, and markets in most cases manage to produce positive-sum outcomes while minimising both zero and negative-sum, exploitative outcomes. So how do we reconcile the mathematically robust results along with various heterodox, ideological criticisms of a market economy that have come together to question the science, with their lack of empirical or practical significance? Given the indispensability of markets at any level of development, along with the significant role they are likely to play in designing policy solutions for many of the real-world challenges mentioned above, a wholesale rejection of the fundamentals of economic science risks throwing the proverbial baby out with the dirty bathwater.

Selfishness, Self-Interest, and Altruism within the Trade Model

To better understand the information requirements that define the product space within which trade can be consummated let's translate the payoffs defined in Game # 2 in terms of the potential surplus that two parties - say, Robinson Crusoe and Friday - can enjoy if they end up choosing to trade with each other rather than produce the traded goods themselves (i.e. the non-cooperative outcome). The gains from trade,

or surplus, is then simply the difference between the maximum price Crusoe is willing to pay for the good and the minimum price at which Friday is willing to sell his goods. Thus, mutually beneficial gains from trade can occur anywhere within the output space bounded by the respective indifference curves that radiate out from **M**, the endowment point as illustrated by the Edgeworth box in Figure 1 below.
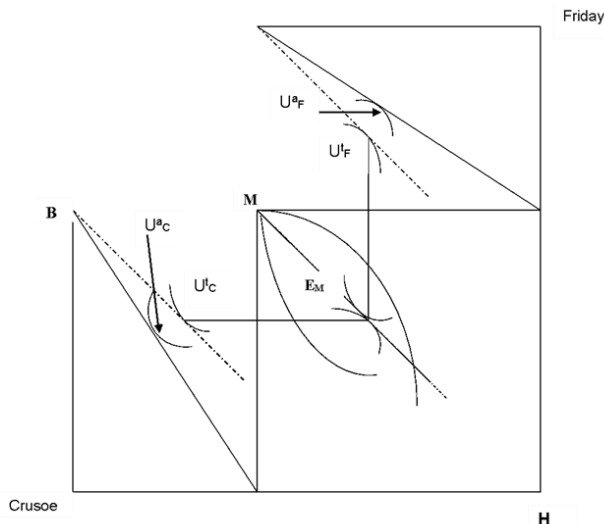

Figure 1: The Possibility of Mutually Beneficial Trade

What assures us that trade will be consummated between Crusoe and Friday? Each may be tempted to extract the full potential surplus and in doing so, end above. An answer comes to light once we realise that Giraud (2003, 2022) confounds the "selfish agent" with Smith's "self-interested" agent.

The two types ought to be seen as working with very different choice psychologies in the above two-person trade context: selfish agents seek to appropriate the full extent of the surplus for themselves. That is, the seller wishes to charge the buyer the maximum the buyer is willing to pay, and nothing less; while the buyer wishes to offer the minimum price, the seller is willing to sell for and nothing more. Each selfish agent thus drives the other to the brink of indifference to trade – i.e., back to the level of utility set at the M corner position in the inner Edgeworth box of Figure 1.

Smith's hope for trade instead is pinned on the choice psychology of self-interested agents which he distinguished from the altruistic sort. Thus, in a

memorable passage, Smith argued - *"It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest".*[5] It is to this choice psychology that we must turn in order to better assess the likelihood of trade vs. no trade.

The Science of Cost and Choice: Recognizing the Differential Information Burdens

The hypothetical payoff structures contained within the game theoretic models do not reflect the information requirements that burden individual choice in real-world markets. That is, the game theorist in constructing the payoff matrices suggests only hypothetical choice parameters, and derives outcomes that result from the particular set of in-player strategies assumed by the theorist. As game theorists, however, we should not confuse the strategies hypothesised within these games with actual choices being made in the real world. Nor can we, as econometricians, hope to collect payoff "data" that determines real-world choices – these exist only in the mind of the actual person making the choice and are not available as observational data to be collected. That is, the "data" that informs a self-interested agent in the real world engaged in trade are her opportunity costs. While the concept of opportunity cost was recognized by Smith,[6] it remained in a rudimentary form. We must instead turn to the Nobel Laureate, James Buchanan's (1969) full-fledged treatment of opportunity costs,[7] especially his distinction between choice-determining costs versus choice-determined costs. Economists understand the former as opportunity costs which are purely subjective or "counterfactual" – it is the gain or loss that was sacrificed or avoided when a choice is made. Instead, choice-influenced costs are those that get incurred once the choice has already been made and the agent acts on his or her choice.

The recognition of opportunity cost as a subjective cost known only to the agent making her choices over potential trades helps us identify the significant information differentials between the different agent

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[5] *Smith, Adam (1776) An Inquiry into the Nature and Causes of The Wealth of Nations. Chicago: University of Chicago Press, 1976. The quote appears in Chapter II on the Division of Labor.*

[6] *In his hunter-beaver model of the costs of production – see Smith's discussion of this model in Chapter VI on OF The Component Parts Of The Price Of Commodities in the Wealth of Nations.*

types. Information requirements of the selfish strategy turn out to be of a different sort from those required for a self-interest strategy. The self-interested agent is focused on securing a self-set, minimum net gain - relative to her own opportunity costs. Buyers and sellers considering a possible trade need to know only their own reservation price based on their subjective opportunity costs – in terms of Figure 1, these are the level of utility each obtains with autarky. As long as their respective reservation prices open up a positive good space within which trade is mutually beneficial, trade is likely to occur. Instead, for the selfish strategy to be affected each player requires knowledge of the other player's reservation price – a far higher information burden.

In addition, a selfish strategy is more likely to produce indeterminacy. Thus, in Case # 1 of the non-cooperative game examples provided by Giraud (2022) and illustrated above, each player attempts to exploit the other player's expected strategy to the maximum. The game simply recycles through multiple equilibria without ever settling down. And it's assumed to be a zero-sum game so there is no identifiable pareto-equilibrium to be had in such a game. Instead, a self-interested strategy could well produce a stable equilibrium within the same game. All it requires is an agent for whom the relevant opportunity costs of not playing the game may in fact be -2. In this case, a stable equilibrium is reached when at least one agent sees her game-strategy to be one of loss-minimising for herself, rather than maximising gain over her opponent.

Now consider the altruistic agent. A baker who is driven by "benevolence" or "a desire to do good" faces as great, if not greater, a challenge as the selfish individual seeking to exploit others. Information requirements for "doing good" increase exponentially as the baker seeks to go beyond feeding his immediate circle of family and friends, to supplying individuals and groups unknown to him in the wider market. Thus, the near-insurmountable information

challenges faced in delivering aid in an effective manner have been well known[8]

Finally, once the existence of an actual market, and thus, the existence of market prices for the traded goods are admitted, the information burden is dramatically reduced for self-interested agents. Returning to Figure 1, the market price is established at point E_M and each trader needs to only compare their respective opportunity costs, or reservation price, against given market prices. In contrast, far from easing the information burden for the selfish agent, the establishment of a market price is likely to make it far greater as the selfish agent will find it difficult to price discriminate within a competitive market.

Uncertainty, Choice, and Ethics

Smith in his Theory of Moral Sentiments considers what keeps a self-interest strategy from degenerating into a selfish strategy.[9] The answer Smith provides is the human need for approbation. And the "man within". When dealing under an information veil about the other party's true reservation price, each agent is likely to consider the other with greater sympathy or in her "own image". Plus, selfishness – which when recognized as such will earn greater disapprobation from one's peers. That is when you are recognized by your peers to have knowingly behaved in a selfish manner to exploit the full surplus. Selfish behaviour is also more easily identified in reference to market-established terms of trade than it would be without the benefit of a market reference price.

Conclusion: The Propensity to Trade Trumps Non-Cooperation

The problem of non-cooperation that this essay began with must now take a back seat to the human propensity to trade. It is worth quoting Smith (1776, Chapter II) directly here:

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[7] *Buchanan, James M. (1969) Cost and Choice: An Inquiry in Economic Theory. Chicago: Markham Publishing Co. Buchanan's discourse on costs and choice builds on Smith's hunter-beaver model.*

[8] *The so-called "effective altruism" movement has been a recognition of this basic insight. See this Wikipedia page for an introduction to the thinking underlying this movement: https://en.wikipedia.org/wiki/Effective_altruism philosophy*

[9] *Smith, Adam (1759) The Theory of Moral Sentiments. Clarendon Press, Oxford, 1976.*

"The division of labour, from which so many advantages are derived, is not originally the effect of any human wisdom, which foresees and intends that general opulence to which it gives occasion. It is a necessary, though the very slow and gradual consequence of a certain propensity in human nature which has in view no such extensive utility; the propensity to truck, barter, and exchange one thing for another… It is common to all men, and to be found in no other race of animals, which seem to know neither this nor any other species of contracts. Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog. Nobody ever saw one animal by its gestures and natural cries signifying to another, this is mine, that yours; I am willing to give te this for that."

In the Smithean world, such propensity to trade predates human rational calculus – irrespective of whether such calculus is motivated by self-interest, selfishness, or altruism. One may plausibly argue that any such calculus kicks in only once the likelihood of trade is seen by all participants with a high degree of confidence. Notwithstanding the recent critiques of the core of economics science of non-cooperative game theory, we can, and must, continue to learn from Adam Smith.

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The Future of Health Care in India

Kalilur Rahman

Introduction

A couple of popular quotes for the past techade (a.k.a technical decade as per NASSCOM) go like **"AI is the new electricity" and "Data is the new Oil"**. How can technology change the world of healthcare across the world, especially in a population-dense country like India where access to an excellent healthcare professional is a challenge - especially for economically backward people and people in rural areas with limited access? Take these stats, for example,

- The market size of Artificial intelligence (AI) in **healthcare worldwide** is expected to reach **$USD 95.65 billion by 2028,** up from $USD 6.60 billion in 2021, at a compound annual growth rate **(CAGR) of 46.1%.**

- **Seventy-five per cent** of large healthcare organizations (annual revenue of over USD 10 billion) invested over **$USD 50 million** in AI projects/technologies, while approximately 95% of mid-sized organizations (annual revenue of $USD 5 billion to $USD 10 billion) invested under $USD 50 million.

- Every year, roughly **400,000** hospitalized patients suffer preventable harm, with **100,000** deaths. In light of that, the promise of improving the diagnostic process is one of AI's most exciting healthcare applications.

- It is estimated that data and AI in healthcare can add **$USD 25-30 billion to India's GDP by 2025**. The top areas for AI implementation in the sector are patient care, operations and R&D of various actors in the healthcare space.

The field of healthcare is experiencing a transformation due to the emergence of innovative technologies such as wearable devices, virtual reality, messaging apps, mobile apps, computer vision, artificial intelligence, machine learning, robot-assisted surgery, nanomedicine, and nano-devices. These technologies are opening up new possibilities for

extending human life expectancy. As the global population is projected to reach 8-9 billion over the next 10-20 years, the ageing population is expected to increase worldwide, posing significant challenges, especially in countries like Japan, where the average lifespan is higher than in other parts of the world.

This article explores how artificial intelligence (AI) can benefit the healthcare industry in India. AI has the potential to revolutionize the industry by enabling pharma companies to market their products more effectively and accelerate the drug discovery process. With the explosive growth of AI, India can leverage this technology to achieve significant breakthroughs in healthcare.

Scope for growth in AI Expenditure for Healthcare

The World Economic Forum estimates that India will spend a substantial $11.78 Billion on AI by 2025, a massive increase of about 37 times from the spending of around $318 Million in 2017. This represents an average increase of approximately 4.5 times the base spending. This significant investment is expected to contribute up to $1 Trillion to the Indian economy by 2035.

The high population density in India, coupled with a severe shortage of doctors (with only about 64 doctors for every 100,000 people, compared to the global average of 150 doctors), poses a challenge to healthcare diagnosis and access to medical professionals. However, with the introduction of AI technologies, this challenge can be addressed, leading to positive outcomes for patients.

AI can play a crucial role in automating the diagnostic process and improving the quality of time spent by doctors with their patients. Statistics show that in India, a doctor spends an average of just 1-2 minutes with each patient. With the use of AI-driven diagnostics and analytics, doctors can manage their time more efficiently, resulting in better outcomes for both patients and healthcare professionals.

In addition to this, the advent of Telemedicine and Electronic Health Records has made it possible for doctors to access patient records and provide consultations remotely, further improving the efficiency of healthcare delivery. Overall, the integration of AI technologies into the healthcare sector in India has the potential to bring about a significant improvement in the quality of care and better outcomes for patients.

Tele-Medicine / Remote-Diagnosis / Automated Projections

The healthcare industry in India faces a major challenge when it comes to providing access to primary and secondary healthcare services in rural areas. However, the advent of technological advances, such as telemedicine and virtual consulting, has the potential to address this challenge. For instance, low-bandwidth apps and simple devices can be used to perform scanning, video/voice-based interactions, and pass key vitals using wearables or simple saliva or blood drop-based rapid scans based on DNA/genetic-based tests.

Telemedicine initiatives have already been launched by corporate hospitals, such as Apollo and Max, and start-ups like Practo are providing virtual consulting for simple diagnostics. With increasing data and knowledge, there is the potential to develop condition-predicting bots that could outperform an average doctor. Healthcare professionals may need to become super-specialized and augmented with the help of tools.

Several AI-based start-ups and collaborations in the healthcare sector in India have emerged, showcasing the potential of technology in healthcare. For example, **NIRAMAI** has used thermal imaging and machine learning AI to detect breast cancer, while IIT Kharagpur has developed an AI and IoT-based diagnostic device for **COPD** and other lung diseases. Similarly, AI is being used for screening in automated eye care and predicting tuberculosis by analyzing X-ray images.

By freeing up specialist time and leveraging their expertise for super niche needs, AI can help reduce non-value-adding tasks and enable specialists to focus more on needy patients for a longer time.

By analyzing relevant data efficiently, doctors can improve the quality of their consulting and offer better experience, diagnosis, and treatment.

AI has the potential to play a major role in the improvement of healthcare reforms in India, and it is estimated that India may spend up to $11.78 billion on AI by 2025, contributing up to $1 trillion to th economy by 2035.

Novel and Personalized medicines

India may spend up to $11.78 billion on AI by 2025, contributing up to $1 trillion to the economy by 2035. Take this statistic "According to a study, the cost for pharmaceutical companies to launch a drug in 2015 was estimated to be around US$2.6 billion, which is a significant increase from the cost of $802 million in 2003, following approvals from regulatory agencies such as the US Food and Drug Administration (FDA)."

Indian pharmaceutical companies have traditionally focused on Active Pharma Ingredients and Generics/Biosimilars, rather than novel and innovative medicines compared to their global counterparts. However, the advent of Al progression is bringing about innovative changes in the Pharmaceutical industry. The industry has been using statistical modeling, analysis, experiments, testing, and analysis for ages, and AI/ML and data science are now automatic adoptions. Al makes a significant impact in areas such as Drug discovery and design, Drug repurposing, Drug adherence and dosage, Personalised Medicine, Processing biomedical and clinical data, Rare diseases and targeted/personalised treatment, Digital recruitment for identifying clinical trial candidates, Predicting and forecasting treatment results or progression of diseases, Predictive biomarkers for molecule identification or treatment, Gene Editing, Disease Diagnosis, Medical Diagnostics, and Reporting.

For instance, repurposing is a use case that Indian firms can leverage, where companies are focusing on reusing components/chemicals and molecules in areas that were originally not intended for the original areas of treatment. During the pandemic, several repurposed drugs were identified, such as Remdesivir and Toremifene for COVID-19 treatment. BenevolentAl, a company, identified a drug for rheumatoid arthritis as a potential therapy for

COVID-19, which was then tested on a large scale. With techniques such as "Knowledge Graph" built using chemical, biological, and medical research and information, AI machine learning models and algorithms can identify potential drug leads currently unknown in medical science and far faster than humans. InSilico and labs such as MIT Broad Institute have identified molecules in record time. For example, the MIT team identified a molecule named "HALICIN" aimed to treat the most powerful drug-resistant Bacteria, A.Baumanii, from an earlier discontinued study for diabetes treatment.

Centralized Patient Health Records

It is important to understand the challenges that India faces in maintaining comprehensive health records. Currently, healthcare professionals rely on reports from trusted sources, which can be time-consuming and inefficient. However, technology has the potential to help create a secure and personalized system of records with controlled access.

One possibility is to extend the India Stack, which is a digital infrastructure for storing and sharing information, to include a healthcare-centric Aadhaar. This would allow for a centralized system of health records that can be accessed by authorized individuals. It is feasible to extend the achievements of UPI, Aadhaar, and the forthcoming ONDC to create a healthcare framework that can establish a global benchmark.

Of course, there are regulatory concerns that must be addressed, such as compliance with regulations like **HIPAA** and **GDPR**. However, with proper regulations and access control, a centralized system of health records could provide numerous benefits for both healthcare professionals and patients in India.

3D- Printing in Healthcare

In India, it is difficult to maintain a complete health record, and healthcare providers usually rely on records or reports from trusted sources. How can technology be used to create a secure and personalized system of record with controlled access? Can the India Stack be adapted to focus on healthcare with a dedicated Aadhaar system? Is it possible to manage health records in a centralized way while complying with regulations such as HIPAA and GDPR?

Robot Assisted Surgery

In the field of healthcare, technology is rapidly advancing and transforming various aspects of medical practice. For example, Robot-Assisted Surgery is one of the most innovative technologies being used in the healthcare sector. A notable example of this is the rapid cataract surgery model pioneered by Aravind Eye Hospital, which allows for critical surgeries to be performed in areas lacking proper infrastructure. These surgeries can be performed by healthcare professionals situated locally with the assistance of robots, while specialists located remotely guide the procedure.

Robotic-assisted surgery offers numerous benefits such as minimal invasion, fewer scars, reduced pain and infection, and avoidance of human errors.
Another area where technology can be utilized in healthcare is Virtual Reality (VR). This technology can be used to train healthcare professionals with highly accurate 3D models, providing high-quality training for diagnosis, prediction, and symptom identification. Furthermore, VR can help patients to relax in times of pain and motivate them, thus enhancing their psychological well-being. In summary, the integration of technology in healthcare has the potential to revolutionize medical practice and set new global standards in the industry.

Nano-Medicine

The field of Nano-medicine is a promising area of technological advancement that can have significant benefits for India. Cardiovascular diseases are prevalent in South Asia due to both lifestyle and genetic factors, and nano-medicine and nano-medical devices can offer effective treatment options. However, the high cost of such niche and advanced technologies remains a concern. Personalized medicine, targeted therapy, and sustained-release technologies are also being researched, with the aim of selectively targeting harmful cells and tissues while preserving healthy ones.

Genome and Gene Editing

Gene editing using the CRISPR technique has been applied to humans, resulting in the birth of genetically edited twin babies in China.

Despite the ethical concerns this raises, gene editing is likely to become a reality in some parts of the world. Animal-less meat is also being developed as a healthy alternative to meat consumption, but it too faces ethical debates. In other news, there have been successful cases of HIV cure in at least two cases.

This group may also live in remote areas where access to commercial or government healthcare resources is limited or unavailable.

Centralized Healthcare Options?

In recent years, the healthcare options available in both government and commercial healthcare services in India have seen improvement. The Central and State Governments have made efforts to provide better healthcare within the limitations they face, resulting in an increase in the average lifespan of Indians. However, there is still much room for improvement. For instance, a large number of accident-related deaths could be prevented if victims were treated in the **"Golden Hour"**, but this often does not happen due to a lack of civic sense to allow ambulances to move quickly, as well as a slow response from private and government hospitals. Access to healthcare professionals and systems is crucial, and having a healthcare scheme can help. In comparison, I had a positive experience with primary and secondary care in Canada and the UK. These healthcare systems are well-organized and well-run, albeit with occasional challenges and mistakes. However, wait times for tertiary care or immediate surgery can be a challenge. In India, there is potential for a public-private partnership to create tiered access to healthcare services.

Conclusion

The healthcare sector in India is at a crossroads, where the integration of technology, medical research advancements, and new treatment methods are transforming the industry at a rapid pace. Although significant progress has been made in improving the availability and accessibility of healthcare, India still faces daunting challenges in bridging the economic divide, infrastructure gaps, and lack of systemic processes. However, India's potential for growth and improvement is enormous, and the government's efforts in partnering with private healthcare providers, pharmaceutical companies, research institutes, and diagnostic services are promising. By utilizing cutting-edge technologies such as virtual consultations, automated diagnosis, and centralized health records, India can revolutionize the healthcare sector and improve productivity, which will ultimately lead to overall economic growth.

With its large population and impressive GDP growth, India has the potential to establish a world-class healthcare system that provides quality care to all. A healthy nation is a prosperous and successful nation, and the right initiatives can ensure that India becomes one of the world's leading healthcare providers.

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Evaluating Female Disadvantage: An Analytical Exposition

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Abstract

Female disadvantage is concerned with the discrepancy of females with regard to achievements in different dimensions of well-being in comparison to the respective achievements of males. In this article, we follow an axiomatic approach to the evaluation of female disadvantage and present some policy-related discussions.

Introduction

Of late, female disadvantage has become a major issue of concern, particularly, in the literature on human well-being and social policy. Female disadvantage refers to the extent of deprivation suffered by females when we make systematic comparisons between attainments of females and males in different dimensions of welfare, say health, literacy and income. Consequently, female disadvantage may be treated as a social bad; it represents denial of human rights to females. Hence, from a policy perspective, it is certainly desirable to reduce female disadvantage to the maximum extent possible.

In this article, we develop an axiomatic approach to the measurement of female disadvantage and examine some related policy implications. An axiom represents a particular value judgment which may or may not be verifiable on the basis of factual evidence. For instance, the Strong Pareto Principle which demands that social utility is increasing in individual utilities, is one such postulate.

Formal Analysis

Our analysis in this section is quite general in the sense that that it applies to a country as a whole or any particular region of a country. Let $n \geq 1$ be the number of dimensions of well-being. Let mi and fi

respectively be average male and female attainments in a given dimension i. For instance, if i stands for literacy, then $^y mi$ and $^y fi$ denote respectively the average literacy levels of males and females in the society. For the female-male achievement (FMA) ratios $x_i = \frac{^y fi}{^y mi}$ to be well-defined we assume that $^y mi > 0$ and $^y fi \geq 0$ for all dimensions i. If $x_i > 1$, then females are in an advantageous position than males in the dimension, for $x_i = 1$ their dimensional achievements are the same. For $x_i < 1$ females suffer from disadvantage/deprivation in the dimension in terms of their lower achievement in comparison with achievement of males. We denote the vector of such ratios by x, that is, $x = (x_1, x_2, ..., x_n)$. Each x is an element of $\Re^n +$, the non-negative orthant of the n-dimensional Euclidean space. [1]

An advantage of considering the (FMA) $\frac{^y fi}{^y mi}$ ratios for our analysis is that they are unit-free non-negative real numbers. Therefore, they can be averaged across dimensions in an unambiguous way to arrive at an overall indicator of female disadvantage. A female disadvantage index D is defined as $D: \Re^n + \rightarrow [0,1]$. That is, given the FMA ratio vector $x \in \Re^n +$, the associated level of female disadvantage is specified by a non-negative real number $D(x)$ lying between 0 and 1. It is a simple quantification of the magnitude of deprivations that exists when we compare the female dimensional achievements with those of the male using the FMA ratios.

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[1] *The non-negative orthant of the -dimensional Euclidean space is the set of -coordinated vectors each of whose components is a non-negative real number.*

We now state some intuitively reasonable axioms for the index that become helpful in isolating some satisfactory forms of the disadvantage evaluator.[2] The first axiom we propose is Focus.

Focus: All changes in the achievement in a non-deprived dimension of females that do not make them deprived in the dimension do not alter the magnitude of female disadvantage.

To understand Focus, let us consider the three dimensions of life expectancy (LE), literacy (LI) and real GDP per capita (RG) used by the UNDP for calculating the HDI. Suppose the FMA ratio vector for these three dimensions is given by $x = (0.9, 1.2, 0.6)$. While the females are deprived here in LE and RG, they are non-deprived in LI. Therefore, if the FMA ratio in LI reduces so that it does not fall below 1, say from 1.2 to 1.1, then the level of disadvantage should not alter since here we are concerned with the extent of deprivations of females across dimensions.

The next axiom says that if females are deprived in one dimension, then an increase in their deprivation in the dimension should increase female disadvantage. To understand this, consider again the FMA ratio vector x. Suppose the FMA ratio in IN reduces from 0.6 to 0.55 so that the deprivation of the females in the dimension increases. It is, therefore, sensible to expect that female disadvantage increases. We state this formally in the following axiom.

Monotonicity: A reduction in the achievement level of a deprived dimension of females increases female disadvantage.

While monotonicity examines the implication of reduction in the attainment level of a deprived dimension of females, we can also consider equal sequential reductions in attainment quantity of a deprived dimension of females. For illustrative purpose, suppose that in $\bar{x}$ the FMA ratio in LE reduces from 0.9 to 0.8 and again from 0.8 to 0.7. It is quite logical to argue that the increase in female. **disadvantage following the first reduction in the FMA ratio in LE is less than the corresponding**

female disadvantage increase that results from the second reduction in the FMA ratio in LE. Thus if we denote associated FMA ratio vectors by $x' = (0.8, 1.2, 0.6)$ and $x'' = (0.7, 1.2, 0.6)$, then it is quite sensible to claim that $D(x') - D(x) < D(x'') - D(x')$. The following axiom specifies the idea formally.

Monotonicity Severity (MS): The higher the extent of deprivation of females the larger should be the increase in female disadvantage due to a reduction in the achievement quantity of females in a deprived dimension.

To motivate the next axiom, suppose x in dimension 2, the only non-deprived dimension for females, now becomes deprived for them. Assume that the associated FMA ratio vector is given by $\widetilde{x} = (0.9, 0.95, 0.6)$. Then it is certainly reasonable to claim that has $\widetilde{x}$ a higher level of female disadvantage than x. We state this formally in the following axiom.

Dimensional Monotonicity (DM): If a non-deprived dimension of women becomes deprived, then female disadvantage increases.

The next axiom is related to policy applications of the disadvantage index. A policymaker may be interested in identifying the sources of female disadvantage, that is, those dimensions that are more distressed by female disadvantage. The following axiom becomes helpful here.

Source Decomposability (SD): The overall female disadvantage index is the arithmetic average of dimension-wise disadvantage indices.

Technically, $D(x) = \frac{1}{n} \sum_{i=1}^{n} D(x)$ where $D(x)_i$ is the disadvantage index for dimension. The contribution of dimension j to overall disadvantage is   . When a society eliminates female disadvantage in dimension j global disadvantage will reduce exactly by this amount. Thus, each of these dimension-wise statistics is important from a policy viewpoint.

In view of the Focus axiom, we can suspend our

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[2] *For discussions on multidimensional poverty counterparts of these axioms, see Alkire, Foster, Seth, Santos, Roche & Ballon (2015) and Chakravarty (2018)*

each such ratio suitably. Let

$$\bar{x}_i = \begin{cases} x_i \text{ if } x_i < 1, \\ 1 \text{ if } x_i \geq 1. \end{cases} \quad (1)$$

Thus, the profiles x and $\bar{x}$ have the same number of dimensions and the non-deprived positions of females in x are incorporated appropriately.

We may now illustrate the general formula $D(x)$ by a simple example. It can be shown that the Monotonicity and MS postulates compel us to choose those functional forms that are decreasing and strictly convex in FMA ratios. The SD axiom suggests the overall index should be additive across dimensions. The following can then be taken as simple specification of the general function $D(x)$:

$$D_c(x) = \frac{1}{n} \sum_{i=1}^{n} (1 - (\bar{x}_i)^c) \quad (2)$$

where the two monotonicity postulates impose the following boundary restriction for the parameter c: $0 < c < 1$. As the value of c decreases over the interval $(0,1)$, D_c attaches higher weights to the lower FMA

ratios. For $c = 0$, D_c takes on the value 0. For $c = 1$ and D_c becomes the Dijkstra-Hanmer (2000) index, which violates the MS postulate.[3]

Note that $(1 - (\bar{x}_i)^c)$ values are 0 for all dimensions i in which females are not deprived. For simplicity assume that females suffer from disadvantage in the first q ($\leq$ n) dimensions. Then we may rewrite D as

$$D_c(x) = \frac{q}{n} \frac{1}{q} \sum_{i=1}^{q} (1 - (x_i)^c) = H.V_c(x) \quad (3)$$

where $H = \frac{q}{n}$, the proportion of dimensions in which women are disadvantaged, is the head-count ratio measure of female disadvantage and $V(x) = \frac{1}{q} \sum_{i=1}^{q} (1 - (\bar{x}_i)^c)$ is an average of disadvantages across dimensions. The measure H will reduce only when disadvantage in at least one dimension is completely eliminated.

Concluding Remarks

Since female disadvantage is socially undesirable, it becomes worthwhile to identify the dimensions that contribute more to this problem and implement appropriate improvement strategies.

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[3] *For discussions on multidimensional poverty counterparts of these axioms, see Alki*

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Need for a More Focused Central Bank

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Often there are lumpy payments by firms and individuals from their banks to the government. This leads to a liquidity crunch in the economy. The business sector finds it difficult to get loans from the banks for a while. Accordingly, economic activity tends to suffer. At such times, the Reserve Bank of India (RBI) intervenes to improve the liquidity situation. Though this takes care of the problem, there are some delays and costs attached. So, it is important to find a better solution.

There are at least three examples of a liquidity crunch of the kind considered above. First, a liquidity crunch happens around the time that the government conducts a big auction to sell some 'rights' (e.g. in the telecommunications sector). Second, there is a liquidity crunch around the time of a deadline for tax payments to the government; it can be income tax, corporate tax, GST, and so on. Third, there is a liquidity crunch when the government disinvests from a public sector undertaking. In all these cases, the RBI intervenes to provide liquidity. But let us take a closer look.

There are important and true market failures which require RBI's attention. In this context, there is really no alternative to the RBI. So it is critical that the RBI looks after these functions. The functions of a central bank typically include, broadly speaking, the issue of currency, maintaining macroeconomic stability, regulation of banking, managing foreign exchange reserves, maintaining a sound payments system, and managing public debt though increasingly a separate Public Debt Office or Public Debt Management Agency outside of the central bank and the treasury (or ministry of finance) is performing this function now (for the economics of central banking, see Mayes et al. 2019). It is true that many textbooks include one more function, which is that the RBI acts as the government's banker.

While this is correct factually, it is not quite valid so far as dealing with true market failures is concerned. Why?

The government can use some commercial bank(s) like the State Bank of India (SBI) or even a well-capitalised and reputed HDFC Bank as its bankers (and not just as collection agents). This takes care of the safety of government deposits, given the nature of such banks.[1] Deposits with the RBI in this context are not necessary (this is consistent with Smith 1936). Relatedly, this article argues that the problem of liquidity crunch due to lumpy payments can indeed be handled in an alternative way. We never know when a crisis or near-crisis kind of situation emerges in the macroeconomy. It might just happen in the 'temporary phase' in which the RBI is occupied with or distracted by dealing with liquidity crunch due to bulky payments to the government. It is important that we make a change.

Let there not be any confusion. It is well known that the central bank can and should act as the lender of last resort when there is a liquidity crunch and the market fails to provide adequate liquidity (Bagehot 1873). However, we need to be careful in applying this principle. All cases of liquidity crunch need not be cases of genuine market failure. Some can be cases of pseudo-market failure. This article is considering such a case.

Under the present system, as seen already, when there is a bunching of, say, tax payments, this leads to a liquidity crunch in the commercial banking system. In contrast, under the proposed system, it will merely be a transfer of funds from private accounts to government accounts within the commercial banks. Consequently, there is no liquidity crunch within the commercial banking system when there are lumpy payments to the government under the proposed

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[1] *If required, government can have the status of a senior claimant as a depositor relative to other depositors in the unlikely event of a bankruptcy of a bank where it holds deposits. And, it can help if the government diversifies across some banks.*

system.

It is true that many banks can lose deposits and a few can gain deposits for a while under the proposed system. However, the liquidity-constrained banks can always borrow from the banks, which have liquidity precisely at that time and would indeed want to have an outlet for that money. In this case, there is no need for RBI to act as, what is wrongly called, the lender of last resort here every time lumpy payments are made by the public to the government. The RBI can focus on its core activities.

In fact, the banks which act as the bankers to the government under the proposed policy can, *ex-ante*, sell a line of credit to other banks. When lumpy payments are made, other banks can invoke their line of credit, and borrow from the selected banks. This is a commercial transaction and can be left to the commercial banks (Goodfriend and King, 1988).

It may be that on some rare occasions, the inter-bank market fails despite an ex-ante line of credit arrangement. In such situations, of course, there is a genuine market failure and the RBI will indeed need to intervene. But this is different from the more frequent interventions that have become all too familiar in recent times.

There is another issue. Under the present system, liquidity as measured by the money in circulation with the public (whether we consider the narrow definition or the broad definition of money) shows significant fluctuations around its long-term growth. One reason is that when there are lumpy payments to the government, the money supply falls and later when the government spends the funds eventually, the money in circulation gets restored. We can make an improvement with the proposed system.

At present, the money held by the government in its accounts with the RBI is not included in the empirical definition of money in circulation with the public. This needs to change.[2] Under the proposed system, money held by the government with the banks needs to be included alongside money held by the public in the empirical definition of money. It is true that the government is special and different from the public in many ways. However, this does not imply that it should be special in every way.

It is interesting that in the past the current account facility of the RBI was available not only to the government but also to some other institutions. This was eventually removed (Reserve Bank of India, 2001). The argument above is simply an extension of the argument previously made in 2001. In other words, the current account facility should not be used by the government just as it is now not used by quasi-government agencies.

It may be argued that the RBI or the government is unlikely to follow an advice of the kind suggested here. So it is pointless to make this argument, which is otherwise sound. However, the role of a research economist is to make an argument on the basis of sound economics and persuade the policymakers and the public. The role of an economist is not to see what will be (immediately) acceptable to policymakers (Philbrook, 1953).

To conclude, there are some true market failures and the central bank needs to play an important role in such cases. It is best that the central bank deals with these issues instead of being involved in dealing with the so-called liquidity crunch in the economy due to lumpy payments to the government. That can be dealt with more simply if the commercial banking system is at centre stage for this purpose.

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[2] *It is important to make another change in this context for consistency. At present, the government issues small denomination currency, which makes it an institution on the side of supply of money. The RBI anyway issues the bulk of the currency. The issue of small denomination currency too can be shifted to the RBI.*

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Exploring the link between Natural Disasters and International Trade

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Introduction

There is an increasing recognition of the potential economic and trade disruptions caused by natural hazards. The World Risk Index evaluates 193 countries based on their vulnerability to extreme natural events such as earthquakes, tsunamis, floods, and droughts. This comprehensive assessment covers all United Nations-recognized nations and encompasses over 99 percent of the global population. This index assesses countries on dimensions such as exposure, vulnerability, susceptibility, lack of coping capacities and lack of adaptive capabilities.

According to the World Risk Index Report 2022, three countries - Philippines, India, and Indonesia have the highest overall disaster risk. India, in particular, stands out due to its geophysical and climatic conditions, which make it one of the most[1] disaster prone countries worldwide. A recent study conducted by the Centre[2] for Science and Environment (CSE) revealed that India experienced some form of extreme weather event almost daily during the first nine months of 2022. These events ranged from heatwaves, cold waves, cyclones, lightning, heavy rains, floods to landslides.[3] Tragically, these disasters resulted in the[4] loss of 2,755 lives, affected 1.8 million hectares of crop area, destroyed over 416,667 houses, and caused the deaths of nearly 70,000 livestock.

However, it is important to note that these figures are likely underestimations. The estimation of loss and damage does not fully capture the extent of the impact, as it fails to account for data on public property losses and crop damage. Consequently, the economic consequences of natural disasters on affected countries are even more far-reaching than initially reported.

Natural Disasters and the Macroeconomy

The literature on growth theory discusses the macroeconomic consequences of natural disasters. The neo-classical growth theory (Solow-Swan model) is one theoretical framework which is most widely used to explain the macroeconomic impact of natural disasters. This model assumes an aggregate production function based on capital and labour, with constant returns to scale, fixed savings and depreciation rates, and diminishing returns to capital. According to neoclassical framework, there is a gradual return to the pre-disaster steady state after a shock to the capital stock or labour supply. Natural disasters can have a long-lasting[5] economic impact only if they permanently alter the key parameters that determine the steady state, such as savings, depreciation, or productivity growth. In the short run, these models predict a negative shock to total output, and the impact on per-worker output depends on the relative direct effects on population and capital.

One limitation of the neoclassical growth model is that it assumes technical change rather than explaining it. Endogenous growth models seek to address this limitation. Vintage capital models, an early branch of endogenous growth models, assume that capital always embodies the best available technology at the time of its construction. In these models, investment drives technology, and accelerated depreciation of capital due to a disaster shock leads to higher productivity growth because technology is updated. This is known as the "build-back-better" hypothesis in the literature.

Another branch of endogenous growth models, called models of learning by doing, posits that knowledge

accumulates as people produce more, and productivity depends on variables such as cumulative production or investment. In these models, the destruction of capital or labour may stimulate learning and productivity growth during reconstruction, but this productivity is not embodied in the new capital as in vintage capital models.

Endogenous growth models (Aghion and Howitt, 1992; Romer, 1990), which rely on knowledge creation and commercialization as sources of output and output per worker growth, are not directly affected by natural hazards. Institutional growth models (Acemoglu, 2008), on the other hand, attribute economic growth and development to sound institutions. If these institutions are affected by natural hazards, long-term effects can arise. However, it is more likely that the same institutions that explain growth also contribute to hazard recovery.

Most of these theoretical frameworks operate under the assumption of a closed economy, which is restrictive in today's globalised and integrated world. Trade plays a crucial role for countries to benefit from increased globalisation of products and financial markets. According to the World Bank database, the share of trade as a percentage of world GDP has ranged from 50-60 percent since 2003, standing at 52 percent in 2020 (Economic Survey, 2022). In an open economy, investment may not necessarily equal savings, particularly if perfect capital mobility exists. In such cases, the return to the steady state is immediate due to the inability of the marginal productivity of capital to deviate from the global interest rate. Although instantaneous recovery is an extreme prediction, it can be hypothesised that well-integrated regions with access to finance and resources from other parts of the country (and the world) will recover faster from natural disasters. Therefore, international trade can play a significant role in mitigating the economic impact of natural disasters, especially, in developing countries like India.

Link between Trade and Natural Disasters

Trade plays a crucial role as a "shock absorber" in the face of natural disasters. It allows for the supply shortage in affected areas to be compensated by imports from unaffected regions. Imports are vital for the recovery and reconstruction efforts following a disaster, especially in cases where the damage is severe and a wide range of goods and services need to be sourced externally. Insurance and international reinsurance markets also play a significant role in absorbing losses and shifting the burden of disaster response and recovery from the government to the private sector. Additionally, remittances from nationals working abroad act as an important fiscal buffer for businesses and households, further supporting post-disaster resilience.

It is widely acknowledged that trade is not an end in itself, but a means to achieve balanced, equitable, and sustainable development. In the case of India, the share of trade as a percentage of GDP has steadily increased over the years, reaching 46% in 2021. However, recent estimates from the Ministry of Commerce indicate a significant decline in India's net exports, which fell by over 12.7% to $34.66 billion in April. This is one of the steepest declines in the country's export levels over the last three years. This decline, if it continues, could have significant implications for the country's already struggling growth trajectory, particularly in the manufacturing sector. According to UNCTAD's recent trade update, global trade growth is expected to remain subdued in 2023, with the possibility of a pickup in the second half of the year. In this uncertain scenario, India's vulnerability to natural disasters could further worsen its trade performance in the future.

Natural disasters and weather variations can negatively impact trade through various channels. They can destroy transport infrastructure, increase trade costs, and disrupt the production of tradable goods, particularly in the agricultural and manufacturing sectors. Weather variations and disasters can also affect income, leading to changes in the demand for imports.

In this context, there is an emerging body of empirical economic literature that seeks to identify and quantify the effects of natural disasters, weather, and climate changes on international trade and financial flows. A literature review by Osberghaus (2019) suggests that

exports are generally negatively affected by occurrence and severity of disasters in the exporting country. The impact on imports can vary, with potential decreases, increases, or no significant effect. Heterogeneous effects are observed, where smaller, poorer, and hotter countries with lower institutional quality and political freedom tend to experience the most detrimental effects on their trade flows.

Concluding Remarks

As natural disasters continue to increase in both intensity and frequency, it becomes increasingly crucial to comprehend their nature and the extent of their impact in order to mitigate damages. It is no longer sufficient to solely manage disasters; there is a pressing need to proactively reduce risks and enhance resilience. To gain a comprehensive understanding of the influence of natural disasters on international trade, further research is imperative. This research should begin with comprehensive documentation of the damages inflicted by natural disasters. Subsequently, future studies could delve deeper into the specific impacts of various types of disasters, as their damages can only be compared to a limited extent. Understanding the ways in which natural disasters affect trade flows is essential to prevent future disruptions and ensure the smooth functioning of global trade.

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Business Cycles and Growth Rate Cycles

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Abstract

Economic cycles—whether in the form of the alternating expansions and contractions that define classical business cycles, or the alternating speedups and slowdowns that mark growth rate cycles—are part and parcel of the way market-oriented economies function. Thus, recessions and recoveries—which constitute business cycles—are features, not bugs, in market-oriented economies.

Business Cycles

The National Bureau of Economic Research (NBER), founded in New York in 1920, pioneered research into understanding the repetitive sequences that underlie business cycles. Wesley C. Mitchell, one of its founders, first established a working definition of the business cycle that he, along with Arthur F. Burns (1946), later laid down as follows:

Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration, business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

Today, expansion refers to the phase of the business cycle in which the key measures of aggregate economic activity—output, employment, income, and sales—are increasing in concert, while recession (or contraction) is the phase in which they are decreasing in sync. Together, expansions and recessions make up the complete business cycle.

Defining Recession

A recession is actually a specific sort of vicious cycle, ith cascading declines in output, employment income, and sales that feed back into a further drop in output, spreading rapidly from industry to industry and region to region. This domino effect is key to the diffusion of recessionary weakness across the economy, driving the co-movement of these coincident economic indicators and resulting in the persistence of the recession.

On the flip side, a business cycle recovery begins when that recessionary vicious cycle reverses and becomes a virtuous cycle, with rising output triggering job gains, rising incomes, and increasing sales that feed back into a further rise in output. A recovery can persist and result in a sustained economic expansion when it becomes self-feeding due to this domino effect driving the diffusion of the revival across the economy.

According to a popular misconception—even among economists—a recession is defined simply as two consecutive quarters of decline in real GDP. This is in spite of the fact that the officially recognized 1960-61 and 2001 U.S. recessions did not fulfil that criterion.

This "definition" looks to have originated in an article in The New York Times by Julius Shiskin (1974), providing an extensive list of recession-spotting rules-of-thumb to be used together as confirmatory signals of recession. Just one of these criteria was "two down quarters of GDP."

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As sometimes happens with such things—with no great theoretical justification, but perhaps due to its simplicity—it has been this single "rule" that seems to have survived, confusing generations of economists.

Geoffrey H. Moore, who worked closely with Mitchell and Burns at the NBER, and with whom Shiskin later worked, explained why GDP is not enough to define a recession (1982):

No single measure of aggregate economic activity is called for in the definition because several such measures appear relevant to the problem, including output, employment, income and [wholesale and retail] trade... Virtually all economic statistics are subject to error, and hence are often revised. Use of several measures necessitates an effort to determine what is the consensus among them, but it avoids some of the arbitrariness of deciding upon a single measure that perforce could be used only for a limited time with results that would be subject to revision every time the measure was revised.

Recession Dates

Basically, because of what is meant by aggregate economic activity, as well as issues around revision and measurement error, Moore advocated the determination of business cycle dates based on multiple measures. This approach is, in fact, the basis for the determination of the official U.S. business cycle dates by the NBER, and of business cycle dates for 21 other economies (Banerji and Dua, 2023) by the Economic Cycle Research Institute (ECRI), co-founded by Moore in New York in 1996.

It is thus logical to base the choice of recession start and end dates not on output or employment in isolation, but on the consensus of the dates when output, income, employment, and sales reach their respective turning points. To do any less is to do scant justice to the complexity of the phenomenon known as the business cycle (Layton and Banerji, 2004).

At the root of the matter is the philosophical notion that what defines "an economy" is much more than a broad measure of output, and that business cycles are marked by cyclical co-movements of the key coincident indicators, whose turning points

collectively demarcate the periods of recession and expansion. Thus, it is not appropriate to use a single measure of output as the unique basis for determining recession dates. Rather, what is called for is the determination of the consensus of such coincident indicators about the date of each cyclical turning point (Layton and Banerji, 2003).

Regarding international recession dates referenced in research papers, according to the Bank for International Settlements (BIS), "the most widely used procedure" is to "take the recession dates from the National Bureau of Economic Research (NBER) or the Economic Cycle Research Institute. These rely on expert judgment based on the behaviour of several variables, such as output and employment" (Borio, Drehmann and Xia, 2018).

Recessions start at the peak of the business cycle—when an expansion ends—and end at the trough of the business cycle, when the next expansion begins. In determining those chronologies, therefore, the transition points between the vicious and virtuous cycles mark the start and end dates of recessions.

A recession's severity is measured by the three D's: depth, diffusion, and duration. Its depth is determined by the magnitude of the peak-to-trough decline in the broad measures of output, employment, income, and sales. Its diffusion is measured by the extent of its spread across economic activities, industries, and geographical regions. And its duration is determined by the time interval between the peak and the trough.

Similarly, the strength of an expansion is determined by how pronounced, pervasive, and persistent it turns out to be. These three P's correspond to the three D's of recession.

In the U.S., during the post-World War II period until the early 1980s, the median duration of recessions was ten months, and the median duration of expansions was almost 4¼ years. After the early 1980s, the median duration of recessions has declined to just eight months, while the median duration of expansions has more than doubled to nearly nine years, as the business cycle has become less volatile,

notwithstanding the severe Great Recession of 2008-09 and the short but deep Covid recession.

In India, between the early 1960s and the end of the 1970s, the median duration of recessions was one year, and the median duration of expansions was a little over two years. The median duration of recessions has since declined to just six months, while the median duration of expansions has more than quintupled to 11¼ years, as trend growth has greatly increased.

Growth Rate Cycles

It is clear that in many economies, including the U.S., business cycle recessions had become less frequent, and expansions had lengthened substantially by the late 20th century. In response, Moore at ECRI turned to a different cyclical concept—the growth rate cycle.

Growth rate cycles—also called acceleration-deceleration cycles—are comprised of alternating periods of cyclical upswings and downswings in the growth rate of an economy, as measured by the growth rates of the same key coincident economic indicators used to determine business cycle peak and trough dates. In that sense, the growth rate cycle (GRC) is akin to the first derivative of the classical business cycle, as Graph 1 shows.

**Business Cycles and Growth Rate Cycles**

Economic activity (lower blue line) keeps rising until peak A of the business cycle, which marks the start of a recession (grey shaded area). It falls during the recession until the business cycle trough B, which marks the end of the recession. The rate of growth in economic activity (upper blue line), i.e., the first derivative of economic activity, hits its peak C when economic activity (lower blue line) is rising fastest, and hits its trough D when economic activity is falling most steeply.

The GRC peak and trough dates are determined using an approach analogous to that used to determine business cycle peaks and troughs. The difference is that they are determined on the basis of the cyclical peaks and troughs in the growth rates – rather than the levels – of the key coincident indicators, i.e., output, employment, income, and sales.

On this basis, ECRI determines and maintains the GRC chronologies for 22 economies, i.e., the U.S. and the 21 economies for which it also determines the business cycle peak and trough dates. Please note that these dates are determined for the historical record well after the fact, allowing enough time for the data on the key coincident indicators to settle down, once they are fully available and have been duly revised.

To be clear, these international business cycle and growth rate cycle chronologies are not intended for rapid recession recognition. Nor are they supposed to be used directly for economic forecasting. Rather, they constitute the gold standard reference dates, in relation to which the performance of other economic indicators should be judged. In other words, these chronologies form an essential basis for research into international economic cycles.
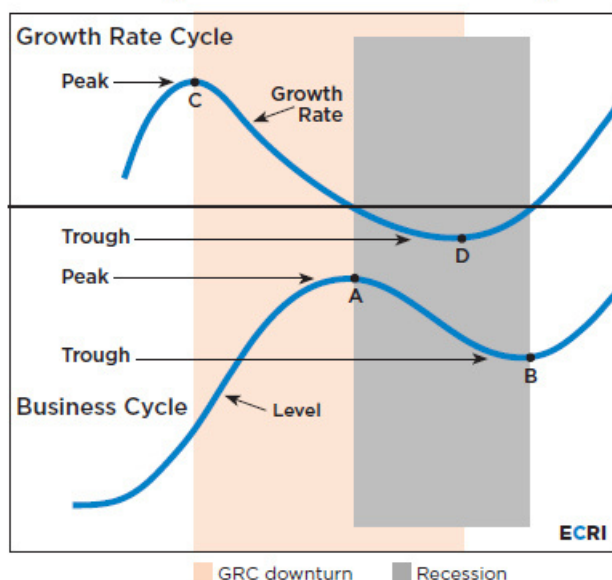
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Lithium Mining in J&K: Transparency is the Way Forward

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GSI announced the discovery of a Lithium deposit in Jammu's Reasi district in Feb, 2023 and started a frenzy all around. There is a high expectation of a boom in the economy, a boost to green energy dreams of India and employment opportunities for local youths of Kashmir. This was mirrored in media headlines such as "Jammu and Kashmir: India's first big lithium find boosts electric car hopes"(BBC), "Lithium deposits found in J&K: Is India's EV drive now set to take the fast lane?" (Economic Times).

Then there were those who sounded a more cautious note. VOA South and Central Asia headlined "Lithium Discovery Seen as Mixed Blessing in India's Kashmir" highlighting the importance of environmental management of lithium mining. It brought out miscellaneous groups of secessionists, fundamentalists, anti-mining lobbyists and those who don't trust the global south to do anything right.

The circumspection is surprising as India is not new to mining and has 1500 active mines and a 700,000 strong mining workforce. But then why this level of excitement on one hand and concern on the other for this mineral reserve? Understanding mining, extraction, economics and environmental concerns associated with lithium is necessary to grasp the various opinions.

To start with, the following are some basic facts about lithium. Lithium is an element with Atomic No 3 and it is the lightest solid metal at a density of 0.534 grams per cm3. It is moderately abundant in the Earth's crust at 65 ppm (parts per million). (Abundance in nature does not necessarily mean easy commercial extraction!) It is silver-white in pure form and is soft enough for it to be cut with a butter knife. Lithium's claim to fame is its use as Li-ion batteries in EVs (Electric Vehicles) and other devices that use rechargeable batteries such as phones etc.

The uses arise out of it being a metal (a cation) and having a very low density. Lithium-ion cells can store a high amount of energy while maintaining their compact size. This makes Li-ion batteries have one of the least weights for a given amount of energy storage. EVs need large storage to give range and low weight for ease of traction. So Li-ion batteries are a very attractive proposition for electric vehicles, phones and other devices which need rechargeable batteries and need to watch weight. Electricity storage, so critical in RE (Renewable Energy) facilities, finds Li-ion batteries attractive. This makes lithium critically important to the green industry. Additionally, Lithium is also useful in the treatment of bipolar disorder.

Electrical vehicles are considered the best option for highly populated cities to control environmental pollution. Going forward this trend will become more pronounced as China, the world's largest car market has announced incentives for EVs. Other important markets are also incentivising its use. The global electric vehicle market is projected to grow from around 8 million units in 2022 to about 40 million units by 2030. To keep pace, Lithium production has to increase to 2 million tonnes in 2030. Only then the projected demand from Electric Vehicles, Renewable Energy sector, smartphones and laptops etc. can be met.

In this landscape, a country's economic security is closely linked to its access to lithium reserves and its extraction. As expected, it is the new arena of big power rivalry. It is necessary to note that economic lithium reserves are concentrated in a few regions of the world. South America's Lithium Triangle of Argentina, Bolivia, and Chile are reported to contain 75% of the world's known lithium reserves.
The ranking of countries by known reserves of lithium is given below:

1.Bolivia (21mill t),
2. Argentina (17 million t)
3. Chile (9 million t)
4. United States (6.8 million t)
5. Australia (6.3 million t)
6. China (4.5 million t)

China has established itself as the dominant player in the lithium market. China has 16% of the world's lithium reserves, controls 50% of global lithium production and 60% of the electric battery production capacity. China is poised to acquire the capability to supply 60% of the world's EVs by 2030. China has made multi-billion dollar investments in global lithium deals. In recent years, it has been buying stakes in lithium assets in South America and Australia, the principal sources of the metal. Bolivia is seeing some close jockeying for lithium reserves between Germany and China. Aggressive lithium acquisitions have established China as not only the dominant player but, as some apprehend, having a chokehold over the electric vehicle industry of the future. This overt commercial aggression by China had the unexpected outcome of European countries and the Americas doubling down on domestic lithium exploration. Some explorers believe Canada may have significant lithium reserves. All this clearly shows that lithium has occupied centre stage in big power chess.

In such a sensitive environment Geological Survey of India (GSI) announced India's first lithium find on February 9th, 2023. GSI report said that for the first time, India has established 5.9 million tonnes of inferred resources (G3) of lithium in the Salal-Haimana area of Reasi district of J&K. The frenzy that followed was only natural especially as no one wants to land in a Chinese chokehold. Moreover, this becomes all the more important as India has made an ambitious green energy commitment of producing 50% of electricity through non-fossil fuel sources.

It is easy to understand the excitement. But why is there trepidation about the news of the first significant Lithium find in India among some? Firstly, environmentalists and communities have not been enamoured by mining activities globally. Secondly, lithium extraction is quite water-intensive and results in increased desertification in parts of the world.

Apprehension of people to mining endeavours is quite widespread and is loosely expressed as "The resource curse". The term summarizes a paradox that countries with an abundance of natural resources tend to record slow economic growth.

This is an observed paradox and in no way an inescapable destiny. It has more to do with regulatory shortfalls in those countries and is part of all-around governance failures there. So, all the economic and social ills in those countries cannot be laid at the doorstep of the mining industry. It is possible to bring social upliftment through mining but that discussion is for another day. Canada and Australia are well recognised examples that mining revenues can be put to socially useful purposes. This can start a cycle of economic activities leading to a manufacturing and services boom bringing about wider economic well-being.

Then there is fear of environmental degeneration with a consequent impact on the agrarian economy. Lithium deposits are found in underground brine reservoirs as well as in hard rocks. Lithium in compound form dissolves in water and travels down the rock formations till it is deposited in sub-surface brine solutions. For extraction, the surface rock is drilled and the brine solution is pumped out and stored in fields for evaporation. This process is water intensive, to the tune of 5 mill litres per tonne. This causes competition for water with local agriculture. On the other hand, in lithium reserves in hard rock, apprehensions arise of air and water pollution causing health concerns among employees and nearby communities.

The mining project starts with the preparation of the Environmental Impact Assessment and Environmental Management Plan (EIA&EMP). Indian consultants with good expertise in the field are available for the preparation of these reports and guidance. Mines Act prescribes robust practices for the health, safety and welfare of employees and communities during the operating life of the mine. Central Pollution Control Board (CPCB) has developed comprehensive standards for pollutant levels and reporting methods for air, water and effluents which have to be mandatorily followed. A mining company also has to commit to reclamation

and provide a financial guarantee for it right at the beginning under Mine Closure Plan. Stabilisation and isolation of waste dumps are covered in it. Inadequate communication is the reason some people have apprehensions even when such an exhaustive framework exists. This causes a lack of trust between the mining company and the community. The mining industry, in its own interest, must win over the confidence of regulators, employees and neighbouring communities.

India has successfully carried out delivery of governance through a revolution in connectivity, and digitisation at an unprecedented scale. The mining community can draw on the lessons and think out of the box solutions to enhance trust between the mining industry, regulators and the community.

There are many parameters of environmental significance which can be continuously monitored. Constituents of air, pollutants of concern in water, noise level, suspended dust particles, and constituents of concern in effluents are some such parameters. These continuous values can be uploaded to a dedicated website making it accessible to all stakeholders. Local Gram Panchayats can engage domain experts to analyse and advise. It is to be remembered that these local self-governance units have access to funds from District Mineral Foundation and the Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY). This publication of continuous monitoring with access to all stakeholders will keep mine owners and regulators on their toes.

Transparency will rob local power brokers of their potential to misinform and brew trouble. Every challenge throws up a new set of opportunities. The record rate of digitisation happened in India when Covid fury was at its peak. Can we now digitise and disseminate environmental management parameters when working on the lithium mine in J&K is under heightened scrutiny?

Who will be proved right? Those who are cheering or those who are apprehensive? Commercial success will be decided by how well we estimate, plan and implement. Further, lithium found in J&K can be a real boon to the State by bringing in large investment and employment if the transparent implementation of well-understood best practices can be sincerely implemented.

There is a long way to go before investments in this lithium deposit in Reasi can be expected to flow in. The confidence in the information from exploration right now is at the G3 level of UNFC which GSI is calling as Inferred. Hard money goes to hard reliable data. The reserve would need further detailed exploration to get there. Once the exploration reaches confidence-inspiring levels, a detailed feasibility report including processing method, cost, logistics and market etc has to be worked out. Only then investors' purse strings can be loosened.

How successful will lithium mining be in India will be decided by how well we accomplish this. We must do it right as a lot is at stake.

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