

Unveiling the Multifaceted Implications of Artificial Intelligence Adoption on Sustainable Development: Perspectives and Hurdles

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Abstract: The rapid evolution of information technology continues to exert significant disruptive forces on various societal facets. Amidst this transformation, digital adoption has emerged as a potent driver reshaping social well-being and economic landscapes. While prior research has predominantly examined socioeconomic elements within the realm of sustainable development, our study uniquely focuses on unraveling the intricate interplay between information technology and sustainable progress. This research endeavors to investigate the multifaceted impacts of digital adoption, shedding light on its profound influence across diverse dimensions linked to the Sustainable Development Goals. Specifically, we delve into critical aspects such as alcoholism, unemployment, literacy rates, research and development expenditure, GDP growth, and the influx of personal remittances—an often-overlooked facet of economic vitality. Our comprehensive analysis unveils a panorama where digital adoption distinctly contributes to positive advances in literacy levels, economic prosperity facilitated by migrant remittances and stimulation of research fostering innovation. However, the transformative journey of digital adoption also casts its shadow, giving rise to challenges in the realm of sustainable development. Notably, it exacerbates issues like bolstering GDP expansion, alcoholism and unemployment. The advent of digital adoption, with its inherent capacity to enhance information symmetry, paradoxically coincides with an upsurge in alcohol consumption. Moreover, the proliferation of information technology, particularly in the form of IT capital, precipitates workforce displacement, necessitating strategic interventions for skills redevelopment to ensure sustainable employment—a crucial imperative. In essence, this study augments existing knowledge by offering nuanced insights of paramount importance to policymakers, societal stakeholders, and organizations alike. By illuminating the potential pitfalls of digital adoption, notably the perils of unemployment and alcoholism, our findings underscore the urgency of implementing mitigation strategies. Notwithstanding these challenges, our research casts a positive glow, guiding strategic investment decisions at the macroeconomic, social, and organizational echelons. In conclusion, this paper navigates the intricate terrain of information technology's integration into society, unearthing both its promising prospects and inherent challenges. By accentuating the multifaceted relationship between digital adoption and sustainable development, our study enriches the discourse with vital perspectives, thus facilitating informed choices for a digitally empowered future.

Keywords: Sustainable development goals, Technology adoption index, Social well-being, Economic disruption, Job displacement, GDP contribution, Research and Development spending, Literacy, Alcoholism

1. Introduction

The transformative force of "Information and Communication Technology" (ICT) has been widely acknowledged as a catalyst capable of reshaping the landscape of work and employment [1] and [2]. This technology possesses the capability to replicate the predictable and repetitive tasks that humans traditionally undertook, ultimately leading to the disruption of these job roles. The advent of disruptive technologies such as "Artificial Intelligence (AI), Machine Learning (ML), Robotic Process Automation (RPA), and other automation" tools has been particularly notable in this context, with these

innovations markedly substituting human labor technologies [3]. The impact of these technological disruptions on work dynamics and opportunities has garnered significant research attention [4], [5]. Notably, this disruption, as foreseen by [4], [5], could culminate in a substantial replacement of jobs over the next two decades, juxtaposed with a projected 200% return on investment. However, this technological revolution simultaneously presents challenges, including heightened labor regulation for low-skill workers [6], [7]. Furthermore, the integration of technology can usher in labor displacement, a theme reiterated by scholars such as [8]. In the broader context of sustainable development, the Sustainable Development Goals (SDGs) serve as a globally endorsed blueprint aimed at fostering a more sustainable future by 2030 [9]. Encompassing a spectrum of ambitions, these goals seek to combat poverty, protect the environment, and enhance the quality of life across developing and developed economies through seventeen key objectives. Many of these goals bear a direct or indirect relationship with technology, often

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encapsulated under the banner of Information and Communication Technology for Development (ICT4D) [10], and [11]. These spheres invariably intersect with socio-economic challenges, ultimately highlighting technology's role in shaping multifaceted solutions.

Given the inherently disruptive and opportunistic nature of technology, this study endeavors to identify factors within SDG goals that intersect with technology's influence. Key areas of focus include employment, literacy, research and development, GDP, personal remittance via migration, and alcohol consumption—each of which is intricately tied to distinct SDG goals. These technological associations with SDGs are detailed in Table 1, drawing upon the framework provided by the International Institute for Sustainable Development [11]. As the subsequent sections unfold, this study will delve into an in-depth literature review of the variables outlined in Table 1. By scrutinizing these variables, we aim to comprehensively understand the interplay between technology adoption, sustainable development, and the intricate socio-economic fabric within which these concepts are entwined. Through this inquiry, we endeavor to shed light on the potential opportunities and challenges that lie at the intersection of technology and sustainable development, contributing to a broader understanding of this evolving relationship.

Table 1. Technological association with SDG Goal [11]

#	Areas	Relevant SDG
1	Digital adoption or Technology adoption index (DAI)	Goal: 9 Foster innovation
2	Unemployment, and underemployment rate (UER)	Goal: 8 Productive employment, and decent work for all
4	Average Literacy Index (ALI)	Goal: 3 Equitable, and quality education
5	Personal remittance received (PRR) (a portion of the contribution to GDP), and GDP growth	Goal: 9 Sustainable economic growth
6	Spending on R&D (RDE)	Goal: 9 (9.5) Enhance scientific research
7	Alcoholic consumption index (ACI)	Goal: 3 Health, and well-being

The subsequent section will have a literature review for all these variables in Table 1.

2. Literature Background

2.1. Digital Adoption Index (DAI)

The DAI [12] is a global index of digital adoption in three dimensions such as the “economy – people, government, and business”. DAI observation covers 183 economies for the years 2014 and 2016. These indexes are measured from the perspective of increasing productivity, business growth, opportunities, the social welfare of people, efficiency, and accountability of the government. Innovative technological changes reduce transformative costs while technology substitutes labour, thus reducing transaction costs. ICT has given a positive impact by providing higher productivity and led to sustainability in the long run [13], and reflected on the socio-economic situation in a positive way. The use of IT (capital) reduces transaction costs in the form of coordination costs. [14] defines transaction cost as the cost of negotiation, monitoring, and enforcement. Transaction cost operates based on an assumption such as bounded rationality [15]. The agency and transaction cost theory [15], and [16] explain risks such as long-term contractual issues, unexpected transaction, and management cost, which leads to long-term lock-in. To mitigate the risk of lock-in, it is essential to have information symmetry for buyers, and consumer in the marketplace and IT plays a major role in information symmetry [17], and eliminates price discrepancy. As digital adoption plays a role in the socio-economic factor or other terms “sustainable development”, it is quite relevant to compare DAI with other SDG goals in our study. The World Bank facilitates providing these data and these data will be used to analyze technological/digital adoption across developed and developing countries.

2.2. Unemployment rate (UER)

Unemployment, the state of lacking a job, exerts far-reaching effects on both macro and micro-economic realms [18]. Conversely, underemployment, characterized by inadequate job positions, incurs a reduction in output vis-à-vis productivity. Ernst and Young [19], [20] predicted that 75 percent of ICT graduates will be unemployed by 2030. Over a two-decade span, these two factors collectively precipitate a staggering reduction of US \$400 billion in output and a one percent decline in GDP [18]. Within this context, social costs, encompassing the erosion of earnings, self-confidence, and self-esteem due to unemployment and/or underemployment, emerge as a defining concern [18]. The increase in social costs perpetuates a cycle of individual and societal adversities. The disparity in technology adoption rates between European nations and the United States since the 1980s has resulted in significant unemployment discrepancies, notably propelled by the swifter pace of technology adoption in the US. The surge of disruptive technologies, coupled with the advent of the Fourth Industrial Revolution (IR 4.0), has cast a shadow over employment prospects. This transformation has placed

10 to 80 percent of jobs at risk [21], necessitating skill re-development as a crucial countermeasure. Notably, technological shifts have rendered 47 percent of jobs vulnerable in the US, a phenomenon aligned with Sustainable Development Goal 8 [22], and [23]. A cornerstone of sustainable development lies in providing high-quality employment opportunities. The wake of technological advancement and automation has disrupted economies in most industrialized nations [24]. This disruption has flagged a startling reality—with 59 percent of jobs susceptible to automation [25], ushering in an era of on-demand societies. Technological metamorphosis [18] has spurred automation, concurrently precipitating unemployment and/or underemployment. The labor market quagmire ensues when labor supply falls short of demand—a predicament exacerbated by the lagging pace of the labor force in keeping stride with technological acceleration. This disjuncture in labor market dynamics led the US government to offshore certain high-skill and cost-intensive tasks to foreign shores [18], inadvertently seeding socio-economic predicaments within the domestic labor force. The ascendancy of Information and Communication Technology (ICT) capital, remarkably potent in its marginal productivity [26], accentuates the intricacies of this paradigm. Given the pivotal role of employment concerns in the framework of sustainable development, our study orchestrates an exploration of the unemployment rate in tandem with the Digital Adoption Index (DAI). This dual approach seeks to glean enhanced insights into the intricate interplay between technological evolution and socio-economic well-being.

2.3. Average literacy rate (ALI)

The correlation between literacy levels and technological and social changes has been emphasized [27], [28]. Increased literacy is intricately linked to accelerated technological innovations and fostering rapid advancements. Literacy plays a pivotal role in facilitating extensive information-seeking behaviors, consequently shaping user perceptions and experiences. Notably, the literacy rate intersects with the Technological Capability (TC) index, as explored by [28]. A notable case is observed in China, where a high Human Development Index (HDI) of 12.465 coincided with a substantial TC index of 3.192, distinguishing it from other developing nations. In this context, policymakers wield significant influence by considering the synergy between TC and HDI indices. This approach aids in determining whether bolstering literacy levels is requisite. The significance of literacy levels in multiple dimensions has been highlighted in studies by [29]. These dimensions encompass poverty alleviation, improved education systems, and an elevated quality of life. Our research further delves into the intricacies of the literacy rate, scrutinizing its association with DAI.

The profound relationship between literacy levels and the trajectory of technological and societal change has garnered considerable scholarly attention. Evidently, a heightened level of literacy serves as a catalyst for accelerated technological innovation. Proficiency in reading and comprehension facilitates swifter assimilation of novel concepts, enabling individuals to engage with emerging technologies effectively. The symbiotic interaction between literacy and technological advancement is further underscored by its role in reshaping user perception and experience through information-seeking behaviors. Notably, the literacy rate is intrinsically tied to indices such as the Technological Capability (TC) index and the Human Development Index (HDI). China's exemplar scenario elucidates this relationship, where a high TC index (3.192) corresponds to a robust Human Development Index (HDI) of 12.465. The alignment of these indices offers policymakers a unique vantage point to gauge the need for enhancing literacy levels. By juxtaposing TC and HDI indices, policymakers can discern the strategic imperatives of boosting literacy to foster both technological prowess and human development. Literacy's expansive impact reverberates across societal realms, extending beyond technological domains. Engaging with an array of scholarly voices [29], it becomes evident that literacy serves as a pivotal tool in eradicating poverty, enhancing educational standards, and elevating the overall quality of life. This nexus between literacy and multifaceted development lends credence to the significance of scrutinizing literacy rates in the context of the broader Digital Adoption Index (DAI) analysis. The ensuing section will delve into an in-depth examination of literacy's multifaceted dynamics, unravelling its interplay with technological advancement and its role in shaping sustainable progress.

2.4. Personal remittance received (PRR)

Personal remittance received (PRR) holds a pivotal role as a constituent of GDP, contributing to the economic vitality of respective economies [11] and [30]. The World Bank quantifies this contribution as a percentage of GDP, encompassing personal transfers and compensation of employees—where compensation denotes income derived from non-citizen in migrant location. The essence of personal remittances lies in the financial support extended by non-residents to their home economies, often driven by employment abroad. This fiscal inflow not only bolsters GDP but also bears implications for sustainable development, with its potential to enhance social well-being by alleviating poverty [31]. However, diverse perspectives on PRR's impact underscore the complexity of this phenomenon. While proponents argue for its contribution to both economic and social well-being, conflicting arguments posit that migrant workers, though aiding economic prosperity, might not necessarily be recipients of enhanced social well-being [32]. Extensive scholarship has

scrutinized PRR's economic implications [33], [34], and [35], often focusing on economic development and welfare. However, the interplay between personal remittances and digital adoption remains relatively uncharted. By juxtaposing PRR and the Digital Adoption Index (DAI), this study endeavors to unveil potential associations between personal remittance flows and technological integration, providing a comprehensive perspective on their roles in the broader sustainable development context.

2.5. Spending on Research, and Development (RDE)

The relationship between research and development (R&D) spending and its impact is a complex terrain marked by varying findings. While the absence of a positive effect of R&D expenditure on exports, other studies emphasize the value brought by innovation and underscore R&D as a conduit to fostering innovation. Intriguingly, the benefits of investing in employee training have been positioned to surpass those of R&D spending [36]. The upward trajectory of R&D expenditure, particularly in conjunction with Information and Communication Technology (ICT), has been noted [37]. However, studies probing the correlation between sustainable development and R&D remain limited. While [38] establish a positive correlation between socioeconomic well-being and R&D expenditure—a cornerstone of sustainable development—[39] introduces the intricate influence of ICT, R&D, and technical know-how on Total Factor Productivity (TFP). Amidst these divergent perspectives, this study's focus on R&D expenditure and its relationship with the Digital Adoption Index (DAI) assumes prominence. Through this exploration, the study seeks to disentangle R&D's role in technological integration, offering insights into its multifaceted implications within the realm of sustainable development.

2.6. GDP growth (GDP)

Although Gross Domestic Product (GDP) has traditionally served as a cornerstone metric for economic evaluation, its capacity to measure sustainable development has been debated. Originating as the System of National Accounts (SNA) [40], GDP might not inherently encapsulate the holistic spectrum of sustainable progress. However, a nuanced examination reveals that GDP, while not a direct measure of sustainability, shares intricate connections with other factors that contribute to it. Intriguingly, personal remittance received (PRR) and GDP are interlinked, with PRR constituting a percentage of GDP. This symbiotic relationship underscores how PRR bolsters GDP directly, while the Digital Adoption Index (DAI) contributes indirectly, as previously expounded. Early studies [41], and [42] have unveiled the positive symbiosis between technology, GDP growth, and increased investment in research and development. Although GDP primarily reflects a nation's economic prowess, it's vital to acknowledge that

it's not a comprehensive gauge of societal welfare. Some investigations have delved into indirect relationships between technological change and sustainable development's impact on GDP [43]. Notably, fiscal policies exert a direct influence on GDP, potentially entailing repercussions for sustainable development. Certain strands of research reveal promising correlations, with technological entrepreneurship [44] contributing significantly to average GDP growth, accounting for 41.49 percent. This growth is often attributed to technological advancements in conjunction with other contributing factors. One noteworthy facet is the elevation of income due to technological change, contributing to GDP growth. In the context of this study, the exploration delves into the intricate web of relationships between technology, as represented by the Digital Adoption Index (DAI), and other parameters aligned with Sustainable Development Goals (SDGs). By scrutinizing these correlations, the study endeavours to unravel the multifaceted dynamics linking technology, GDP, and sustainable development.

2.7. Alcoholic consumption index (ACI)

Exploring the interface between alcoholic consumption and sustainable development has remained an underexplored terrain, with limited studies delving into this intricate nexus. The implications of alcoholic consumption on broader societal well-being beckon for deeper investigation. Policy interventions wield considerable influence in regulating access to alcoholic information and subsequently curbing consumption [45]. Strategies to limit exposure to such information have shown promise in attenuating alcoholic consumption trends, thereby contributing to social welfare. Extant research has illuminated the intricate ramifications of alcohol consumption on various socio-economic facets [46]. These studies have exposed the complex relationships between alcohol consumption and issues such as assault, rape, and robbery, unravelling a network of interconnected challenges. However, the role of technology and digital adoption in influencing or mitigating these relationships remains a realm yet to be deciphered. This study endeavors to bridge this knowledge gap by rigorously analyzing the significance of digital adoption in the context of alcoholic consumption and its multifaceted implications for Sustainable Development Goals (SDGs). By unearthing potential correlations between digital adoption and the intricate tapestry of socio-economic challenges associated with alcoholic consumption, this research aims to enrich the discourse surrounding technology's role in fostering sustainable development.

3. Research Problem

The comprehensive review of existing literature illuminates the dual nature of technology as both a disruptor and an enabler within various socio-economic realms. Notably,

technology's disruptive force has been particularly pronounced in the realm of low-skill jobs. Simultaneously, technology serves as a catalyst for the Literacy Index, enhancing information symmetry, and culminating in the augmentation of the Technological Productivity Index (TPI). This augmentation contributes to economic growth, shaping Gross Domestic Product (GDP), and creating employment opportunities. However, while the literature offers insights into the broad dynamics between technology and sustainable development, a specific investigation into the relationship between technology in the form of digital adoption and its impact on Sustainable Development Goals (SDGs) remains an uncharted avenue. Considering the universality of SDGs and the sweeping disruptions ushered in by technology, delving into the influence of digital adoption on sustainable development assumes paramount significance. Given the intricate interplay between digital adoption and SDGs, this study seeks to fill this knowledge gap by unraveling the nuanced relationship between technological integration and sustainable development. Through a comprehensive exploration of this unexplored territory, the study aims to decipher the extent to which digital adoption contributes to the attainment of SDGs, fostering a holistic understanding of technology's role in shaping a more sustainable future. The holistic overview of various sustainable factors within the context of this study and its technology relations, as presented in Figure 1, encapsulates the essence of the literature background discussed above, framing the intricate landscape that this study endeavors to navigate.

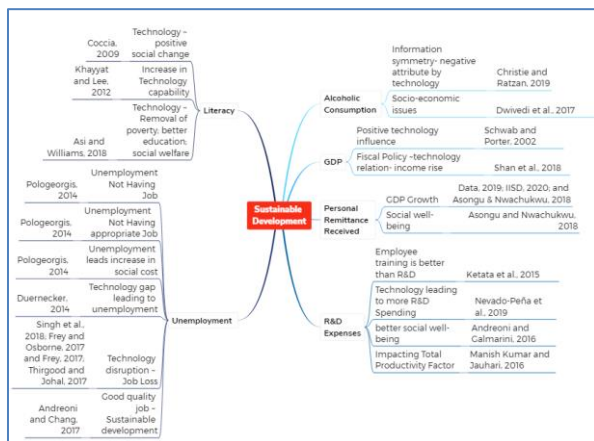


Fig 1 Mind map of sustainable factor of problem analysis

4. Questions

Building upon the multifaceted factors elucidated in the preceding literature, our study seeks to forge a novel perspective by interweaving critical elements such as Unemployment Rate (UER), Average Literacy Index (ALI), Personal Remittance Received (PRR), Research and Development Expenditure (RDE), Gross Domestic Product (GDP), and Alcoholic Consumption Index (ACI) with the Digital Adoption Index (DAI). This integrative approach

aims to shed light on the intricate relationship between technological adoption and Sustainable Development Goals (SDGs). In this context, the study poses the following research questions.

1. Does digital adoption exert a positive influence on unemployment rates, thereby potentially fostering job creation and economic well-being?
2. To what extent does digital adoption contribute to the enhancement of average literacy levels, consequently aligning with goals of equitable and quality education?
3. Can digital adoption mitigate the detrimental impact of alcoholic consumption, potentially improving health and overall societal welfare?
4. Is there a discernible correlation between digital adoption and GDP growth, indicating its role as a catalyst for sustainable economic advancement?
5. Does digital adoption engender increased spending on Research and Development, thereby fostering scientific innovation and technological progress?
6. To what extent does digital adoption correlate with personal remittance received, and how does this interaction contribute to sustainable economic growth?

By addressing these research questions, our study aims to illuminate the multifaceted relationships between digital adoption and various dimensions of Sustainable Development Goals (SDGs), providing novel insights into the intricate interplay between technology and sustainable progress.

5. Research Methodology: Investigating the Interplay

This study undertakes a systematic approach to delve into the intricate interplay between digital adoption and Sustainable Development Goals (SDGs). The methodology is characterized by a sequential progression, detailed as follows.

5.1. Domain identification and factor selection

Drawing on the SDG contexts delineated in the literature review, the study meticulously identifies pertinent domains that align with the technology-related facets of SDGs. From the array of SDG goals and sub-goals, this study hones in on those that hold direct technological implications. The outcome of this rigorous domain selection process furnishes the essential factors that will inform the study's subsequent phases.

5.2. Conceptual framework development and hypothesis formulation

Building upon the identified factors, a robust conceptual framework takes shape, serving as the bedrock for addressing the research questions in a structured manner. This conceptual framework, in turn, evolves into a platform for hypothesis development, translating each research question into testable hypotheses as outlined in the problem section.

5.3. Data collection and analysis

Leveraging secondary data sources, the study embarks on an extensive data collection endeavor. This compilation of relevant data is then subjected to both descriptive and factor analyses, unveiling patterns and relationships among the selected factors.

5.4. Hypothesis testing and result analysis

The hypotheses formulated earlier undergo rigorous testing against the collected data, enabling the study to scrutinize the relationships between digital adoption and various SDG parameters. The results emanating from these analyses serve as the basis for drawing insightful conclusions.

5.5. Conclusions and implications

The culmination of the study involves synthesizing the results, drawing connections between digital adoption and its impact on SDGs, and deriving meaningful insights. The study's implications are contextualized within the broader framework of sustainable development, offering avenues for future research and policy considerations. The detailed methodology framework, depicted in Figure 2, captures the orchestrated sequence of stages that guide this study's progression.

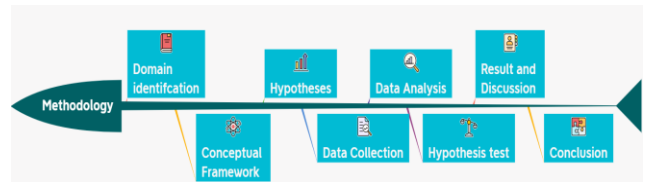


Fig. 2 Fish-borne Methodology

6. Domain Identification and Factor Selection

The focal point of our study lies in the exploration of digital adoption's profound influence on a spectrum of SDG-related factors, as expounded in the literature review. To systematically examine this intricate web of relationships, the study identifies specific independent variables (IVs) that encapsulate distinct technological dimensions [47]. These independent variables, inherently diverse yet collectively emblematic of technological integration, are amalgamated into a cohesive construct denoted as "DIG" (DIGITAL). The consolidation of these IVs into a single entity facilitates the application of single-factor confirmatory factor analysis—an analytical approach chosen to unravel their combined impact. Table 2 comprehensively expounds the constructs, proposed IVs, relevant indicators, and their connections to the literature background section, thereby anchoring the analytical framework. The study's data foundation rests on a secondary dataset, meticulously sourced from the World Bank data catalogue [48] and the Digital Adoption Index [49]. This compilation, aggregating various indicators, lays the groundwork for subsequent analysis. These proposed independent variables, orchestrated under the "DIG" construct, furnish the foundation for the model's development—an endeavor delineated comprehensively in the ensuing Model Development section.

Table 2. Proposed IVs

S.no	Constructs	Proposed IV	Description	Source of data	Literature background (Refer to)
1	Digital Adoption Index	DAI	This is the measure of digital adoption that the World Bank has collected. The data collection is for the years 2014, and 2016. There are 366 records, which cover 179 countries; an average of 2014, and 2016 is used in our analysis. Eliminated null value	[49]	Section 2.1
2	Unemployment Rate	UER	World Bank Development indicator "SL.UEM.TOTL.ZS" "Indicator name: Unemployment, total (% of the total labour force) (modelled ILO estimate)". Year 2018 were taken for this analysis.	[48]	Section 2.2

3	Average literacy rate	ALI	Like World Bank Development indicator "SE.ADT.1524.LT.ZS" but missing lot of data in world bank dataset. Author used data which is compiled from a base of world bank data catalog. "Indicator name: Literacy rate, youth total (% of people ages 15-24)". Year 2015 were taken for this analysis. For calculation converted the percentage to index by dividing it by 100	[48]	Section 2.3
4	Research, and development expenditure	RDE	World Bank Development indicator "GB.XPD.RSDV.GD.ZS" "Indicator Name: Research, and development expenditure (% of GDP)". Year 2017 were taken for this analysis. For calculation converted the percentage to index by dividing it by 10	[48]	Section 2.5
5	Personal remittance, received	PRR	[30]. World Bank Development indicator "BX.TRF.PWKR.DT.GD.ZS" "Indicator name: Personal remittances, received (% of GDP)" Indicator name: Personal remittances, received (% of GDP)". Year 2018 were taken for this analysis	[48]	Section 2.4
6	GDP growth	GDP	World Bank Development indicator "NY.GDP.MKTP.KD.ZG" "Indicator name: GDP growth (annual %)". Year 2018 were taken for this analysis	[48]	Section 2.6
7	Average alcohol consumption per capita	ACI	World Bank Development indicator "SH.ALC.PCAP.LI" "Indicator name: Total alcohol consumption per capita (litres of pure alcohol, projected estimates, 15+ years of age)". Data for the year 2016 is taken for this analysis since no data for the year 2017.	[48]	Section 2.7

7. Conceptual Framework Development and Hypothesis Formulation

The realm of technology's impact on socio-economic change finds theoretical underpinning in a recent study by [50]. This framework introduces four distinct paradigms of digital adoption, encompassing "digital divide, digital harmony, digital accretion, and digital inequality." However, while providing valuable insights into these paradigms, Pollitzer's work refrains from delving into the intricate relationships between technology and broader socio-economic factors. Studies within the purview of digital adoption and transformation have employed the Technological-Organizational-Environmental (TOE) framework for innovation diffusion [51] and [52]. Building upon this foundation, our study embarks on an innovative extension, intertwining the technological narrative with socio-economic dimensions that encapsulate Sustainable Development Goals (SDGs). In particular, our study magnifies the lens to scrutinize the correlation between the Digital Adoption Index (DAI) and a constellation of proposed independent variables. This nexus holds profound implications for sustainable development, encompassing pivotal parameters such as unemployment, literacy, alcoholic consumption, GDP growth, contributions to GDP via Personal Remittance Received (PRR), and Research and Development (R&D) spending. The comprehensive depiction of this dynamic interplay is encapsulated within the conceptual framework outlined in Figure 3. This conceptual framework serves as the compass guiding our exploration, each facet a stepping stone toward deeper understanding.

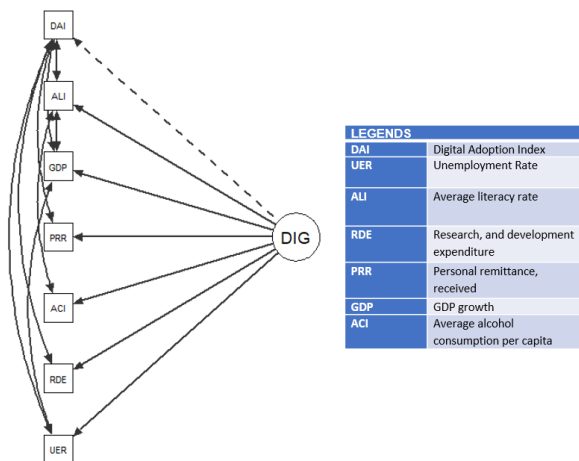


Fig. 3 Conceptual framework of Digital adoption and Sustainable development

7.1. Hypotheses

The following are the proposed hypotheses to address our questions in this study.

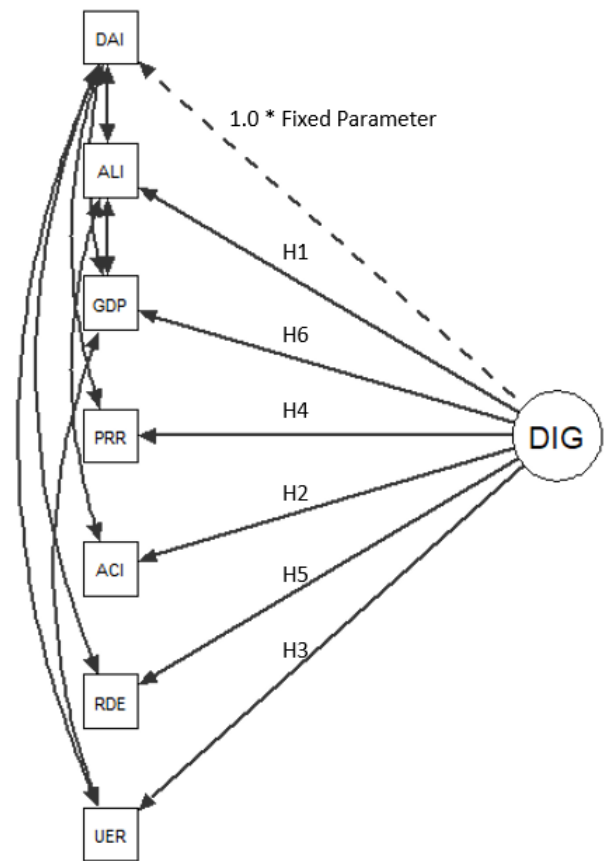


Fig. 4 Conceptual Model with Hypotheses

To comprehensively explore the intricate connections between digital adoption and Sustainable Development Goals (SDGs), our study postulates the following hypotheses.

H1: Digital adoption is positively influencing the literacy rate

The literature underscores the relationship between literacy and technological innovation [27] and [28] with higher literacy levels fostering positive societal change, education, and quality of life [29]. This study will delve into the extent to which digital adoption enhances the literacy rate, contributing to societal upliftment.

H2: Digital adoption is positively influencing the alcoholic consumption

While scant studies have directly linked alcoholism to sustainable development, regulations curbing access to alcoholic information have been advocated [45]. Existing research underscores the connection between alcohol consumption and socio-economic issues [46]. By examining the relationship between digital adoption and alcoholic consumption, this study aims to unearth the potential impact of technology on this critical societal concern.

H3: Digital adoption is positively influencing the unemployment rate

Unemployment and underemployment yield socio-

economic challenges and productivity loss [18]. While technology has been linked to reduced unemployment rates [53], the disruptive nature of technological advancements presents both opportunities and risks [22]. Our study will assess whether digital adoption influences the unemployment rate, thus contributing insights into the technology-labor interplay.

H4: Digital adoption is positively influencing the personal remittance, received

Personal remittance received (PRR) significantly impacts the welfare of recipients in origin economies [31]. This study examines the potential positive correlation between digital adoption and PRR, offering insights into how technology may enhance economic and social well-being.

H5: Digital adoption is positively influencing research and development

Research and Development (R&D) spending's relationship with technological advancement is complex [36] and [37]. Limited studies have explored the connection between R&D expenditure and sustainable development [38]. This study assesses the influence of digital adoption on R&D spending, providing insights into technology's role in fostering innovation.

H6: Digital adoption is positively influencing the GDP growth

GDP growth's relationship with digital adoption is multifaceted, with technology's impact evident in various aspects [44]. This study analyzes the potential correlation between digital adoption and GDP growth, uncovering the technological facet of economic advancement. Through these hypotheses, our study seeks to unravel the nuanced interplay between digital adoption and an array of SDG-related factors, contributing to a more comprehensive understanding of their mutual influence.

8. Data Collection and Analysis

8.1. Dataset and Data collection

The dataset, as illustrated in Figure 5, is meticulously curated from secondary sources, harmonized, and refined to create a unified dataset primed for in-depth analysis. This involved a meticulous process of data cleansing and integration from distinct sources, ensuring its coherence and readiness for exploration. Detailed descriptions of these datasets can be found in "Table 2: Proposed Independent Variables." The Digital Adoption Index (DAI) is sourced from the dedicated DAI dataset, with stringent steps taken to eliminate null values, resulting in a dataset comprising 179 valid records out of the original 183. Employing vlookup techniques, correlations between DAI and the associated factors were established, linking each factor's value to the respective economies. This methodological

rigor aids in building a comprehensive understanding of the interconnectedness of these variables. The resultant consolidated data, representing a synthesis of multiple sources, was efficiently compiled into a CSV format, ensuring accessibility and expediency for subsequent loading and in-depth analysis. This format preserves data integrity while facilitating seamless integration into analytical tools. The subsequent section delves into the intricacies of data validation and analysis, shedding light on the meticulous procedures undertaken to ensure the robustness and reliability of our study's findings.

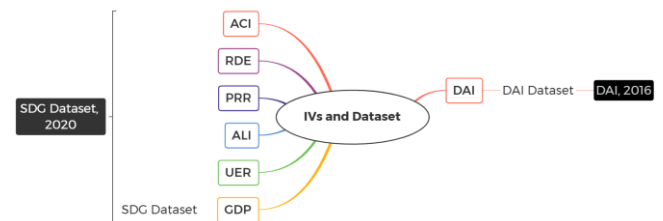


Fig: 5 IVs, and data sources

The data in Table 3 is the descriptive statistics of our dataset used for further analysis. The normality [Shairo-W p value] looks fine since < 0.001

Table 3. Descriptive Statistics

Descriptive	DAI	ALI	GDP	PRR	ACI	RD	UER
N	179	179	179	179	179	179	179
Missing	0	0	0	0	0	0	0
Mean	0.517	86.3	3.18	4.57	6.07	0.529	6.36
Median	0.524	94.6	3.17	1.99	5.74	0.00	4.90
Minimum	0.147	19.1	-6.36	0.00	0.00	0.00	0.00
Maximum	0.871	100	8.58	37.5	20.5	4.88	26.9
Shapiro-Wilk (SW) W	0.962	0.765	0.959	0.712	0.951	0.639	0.886
SW p	< .001						

8.2. Data Analysis

The meticulously curated dataset, as delineated in "Table 2: Proposed Independent Variables," underwent thorough cleansing and was subsequently converted into a CSV file, ensuring its preparedness for the forthcoming analysis phase. For the analysis, our study harnessed the robust

capabilities of the R Platform [54], and [55]. Employing confirmatory factor analysis with structural equation modelling (SEM), along with semPlot, enabled a comprehensive exploration of the data's underlying phase. For the analysis, our study harnessed the robust capabilities of the R Platform [54], and [55]. Employing confirmatory factor analysis with structural equation modelling (SEM), along with semPlot enabled a comprehensive exploration of the data's underlying structure. To ascertain the data's normality, the Shapiro-Wilk test was conducted, yielding p-values of less than 0.001 (Standard: 0.05) (Rydén & Alm, 2010), affirming a normal distribution pattern within the dataset. Given that our present analysis revolves around a single factor with diverse dimensions of data, the reliability was validated using Omega (McDonald $\omega = 0.70$), an accepted standard [56], ensuring the robustness of the factor structure. Furthermore, data validation was reinforced through the examination of Pearson Correlation, as depicted in Figure 6. The resulting correlation coefficients exhibited a range from low to high degrees, all falling within acceptable thresholds [55] and [54].

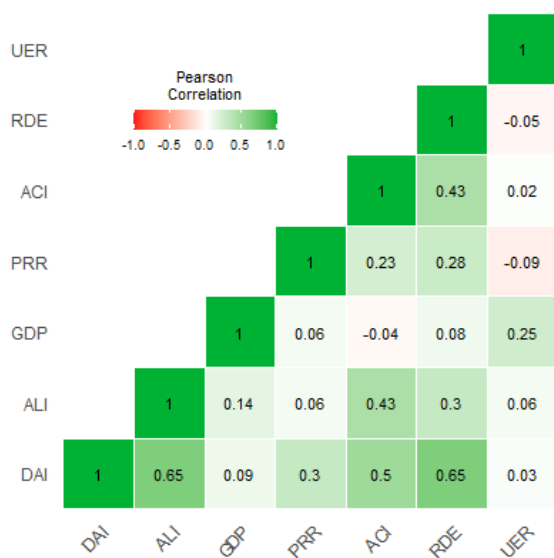


Fig: 6 Pearson Correlation Matrix

Refer to Table 4 as the validity has been done from the statistical perspective. The entire value looks good as the output meets norms of each parameter.

Table 4. Good-to-Fit test

Measure	Name	Description	Norms (for a good fit)	Output	Ref
χ^2/df	Model Chi-Square	To assess the overall fit, and	$\chi^2/df \leq 3$	14.5/1	Hooperr. 2018,

	/ degree of freedom	discrepancy if any		1=1.3	and Kline. 2010
TLI	Tucker Lewis Index	Model of interest improves the fit by 05 percent relative to the null model	TLI ≥ 0.95	0.988	Kline. 2010
CFI	Comparative Fit Index	Compare the fitness of a target model	CFI ≥ 0.90	0.978	Rose.e t.al, 2017, and Kline. 2010
RMSEA	Root Mean Square Error of Approximation	A parsimony adjusted index.	RMSEA < 0.08	0.04	Hooperr. 2018, and Kline. 2010
SRMR	Standardized Root Mean Square Residual	The square root of the difference between the residuals of the sample covariance matrix, and the hypothesized model	SRMR < 0.08 ***0 to 1 deemed acceptable (Hooperr. 2018)	0.04	Hooperr. 2018, and Kline. 2010

Within this analytical phase, the DAI parameter was deliberately held constant at a fixed value (1.00), facilitating an insightful assessment of the relative significance of other factors when juxtaposed against DAI. This was achieved through the application of regression techniques to the remaining factors. The loading outcomes, detailed in Table 5, are compelling indicators of the interrelationship between the factors. Notably, each indicator exhibited robust loading, most of the variables are surpassing the threshold of 0.40 (Hus et al., 2017). This substantial loading underscores the strength of the associations and their pivotal role in contributing to the overall analysis. The loading of

individual variables are ≥ 0.40 except for GDP and UER. As the model is fit and this poor loading for those two variables is considered not significant.

Table 5. Factor Loading

Factor Loadings				95% Confidence Interval		Z	p	Stand. Estimate
Factor	Indicator	Estimate	SE	Lower	Upper			
DIG	DAI	1.000 ^a						0.86982
	ALI	39.500	8.055	23.71	55.29	4.9040	< .001	0.37935
	GDP	-0.695	1.271	-3.19	1.80	-0.5471	0.584	-0.04436
	PRR	-14.922	3.140	-21.08	-8.77	-4.7526	< .001	-0.38777
	ACI	14.437	2.091	10.34	18.54	6.9040	< .001	0.57708
	RDE	4.121	0.508	3.12	5.12	8.1080	< .001	0.74263
	UER	-0.125	2.424	-4.88	4.63	-0.0515	0.959	-0.00413

^a fixed parameter

9. Hypothesis Testing and Results Analysis

Steering our focus towards the outcomes of the data analysis, as depicted in Figure 7, it becomes evident that RDE [Estimate: 4.15/Std estimate: 0.81], ALI [Estimate: 33.40/Std estimate: 0.35], PRR [Estimate: 12.66/Std estimate: 0.36], and ACI [Estimate: 12.15/Std estimate: 0.53] emerge as the most prominent factors, each exhibiting a varying degree of significance. These profound significances are elucidated in the ensuing subsections, wherein our hypotheses are rigorously examined and expounded upon. RDE's substantial allocation underscores its close correlation with digital adoption, while GDP's parallel stature with DAI at 1.0 indicates a balanced relationship. Existing research has explored aspects of sustainable development and technology innovation, as seen in the pioneering work by [57], who delved into corporate sustainable development. Similarly, the study by [58] delved into the impact of digital transformation on intricate business processes. Upon deeper examination, it becomes apparent that while DAI does wield significance vis-à-vis ACI, this association surprisingly ushers in a surge in alcoholism—a lamentable negative impact on sustainable development. Further down the spectrum, GDP [Estimate: 1.09/Std estimate: 0.08], and UER [Estimate: 1.43/Std estimate: 0.05] also manifest less significant ties, with the latter implying a distressing consequence of elevated unemployment rates due to digital adoption. Our current study ventures beyond, comprehensively addressing various facets of digital adoption through the lens of DAI and how they exert influence on the SDGs. The ensuing discussion

dissects the results into two key categories: (1) factors that exhibit significance alongside DAI, and (2) factors that demonstrate no significant alignment with DAI. This analysis is executed by anchoring DAI at a fixed value of 1.0, an approach enabling the direct or indirect measurement of each factor's influence against the backdrop of DAI's regressed impact. Added covariance based on modified indices recommendation for DAI \sim ALI, ALI \sim ACI and UER \sim GDP.

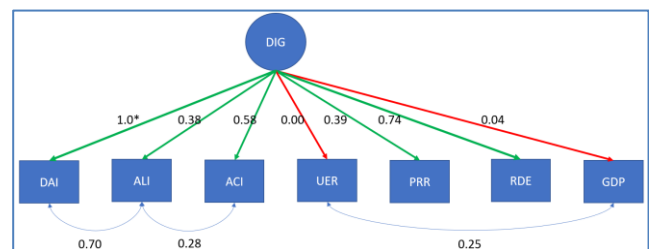


Fig: 7 Outcome of SEM Analysis

9.1. H1: Digital adoption is positively influencing the literacy rate

Directed towards Figure 7 above, the illumination derived from the data unfolds as the literacy rate (ALI) emerges as a force to reckon with, bearing a substantial loading of 0.38. Amidst the backdrop of the digital adoption index (DAI) anchored at a constant parameter of 1.0 within the encompassing single factor termed "digital" (DIG), ALI takes a prominent place among the trio of paramount factors. This pronounced result unfurls a harmonious correlation—digital adoption and literacy are positively intertwined. This alignment between literacy and

technology adoption, potentially synonymous with innovation, ushers in a positive cascade of social transformation. This is corroborated by earlier scholarship, such as the works of [27], and [28] and [29]), wherein it is expounded that such relationships are conducive to pivotal societal shifts like poverty alleviation, elevated quality of life, and enriched education prospects. Delving into Figure 8, an intriguing insight further unfurls—an augmentation in DAI concurs with a corresponding enhancement in ALI, despite the moderating influence of UER. This validation of the hypothesis underpins the fact that literacy levels wield the potential to channel favorable societal transformation [59], a metamorphosis intrinsically tied to the realm of digital adoption. This revised passage captures the essence of the original content while enhancing the fluidity and precision of expression. It adeptly underscores the significance of literacy within the realm of digital adoption and aligns it with well-established scholarly perspectives, all while succinctly encapsulating the findings from Figures 7 and 8.

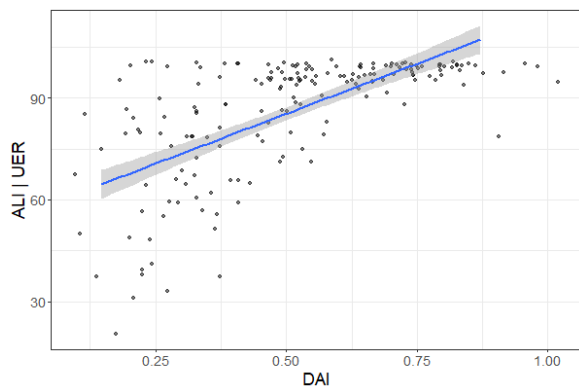


Fig. 8 Outcome of FIT regression line ALI~ DAI with UER as panel variable

9.2. H2: Digital adoption is positively influencing the alcoholic consumption

With a factor loading of 0.58, alcoholism (ACI) ascends as one of the triumvirates of paramount factors. While digital adoption index (DAI) fosters information symmetry [45], an era fuelled by copious news and social media consumption indirectly paves the way for heightened alcoholic consumption. Herein, the ascendancy of ACI is shrouded in a negative connotation, a logical deduction that casts a pall over society. The inherent negative implications beckon forth the necessity of a comprehensive, nation-wide policy to curb the perils of alcoholism (ACI). Figure 9, presented below, offers an unequivocal representation of this relationship. The regression analysis resolutely attests to the direct proportionality between ACI and DAI, a steadfast linkage further fortified by the inclusion of UER as a mediator variable. This empirical analysis incontrovertibly underscores that ACI's significance vis-à-vis DAI unfurls a Pandora's box of socio-economic issues, echoing the sentiments posited by [60] and [46]. While the hypothesis

indeed stands affirmed, it brings forth a litany of societal and socio-economic challenges, signifying an imperative need for a stringent, macro-level policy intervention to navigate these stormy waters. This rephrased rendition encapsulates the essence of the original content while refining the articulation for enhanced clarity and eloquence. It effectively accentuates the gravity of the relationship between digital adoption and alcoholism, substantiating it with both empirical analysis and well-founded scholarly insights.

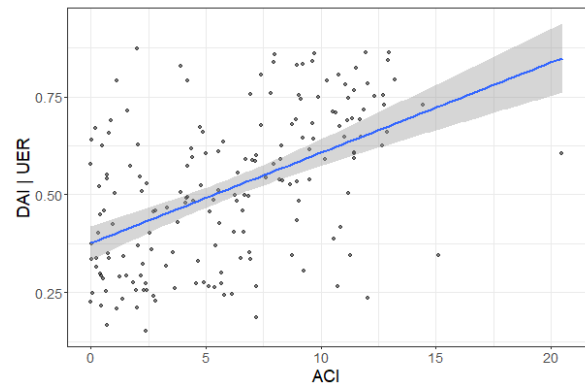


Fig. 9 Outcome of FIT regression line ACI~ DAI with UER as panel variable

9.3. H3: Digital adoption is positively influencing the unemployment rate

Recording a factor loading of 0.003, unemployment (UER) straddles the line of non-significance within this context of data, failing to secure a position within the elite trio of pivotal factors. However, the salient significance of UER's connection with the digital adoption index (DAI) emerges as a harbinger of positive implications and ensuing positivity. The paradox unfolds as heightened technological integration or the ascent of capitalism casts a shadow upon employment rates, ushering in an era where workplaces undergo dehumanization, rendering jobs susceptible to jeopardy (C. B. Frey & Osborne, 2017). In the pursuit of sustainable development, the provisioning of high-quality jobs assumes paramount importance [61] and [24]. The encroachment of technology in the form of robots, AI, and other automated systems emerges as a harbinger of job displacement [62], casting a shadow over the employment landscape from a certain vantage point. As elucidated in Figure 10, the regression analysis underscores a clear-cut correlation between UER and DAI, with ALI assuming the role of a panel or mediator variable. The factor loading (0.003) vs regression in Figure: 10 tells the reality as digital adoption is a disruption since it takes over jobs in the form of IT capital replacement. In this intricate interplay, DAI, morphing into an incarnation of IT capital, takes on the role of a labor surrogate. The implication is profound – this avenue may warrant further exploration, potentially unveiling nuanced insights through an examination at the micro-level across diverse economies (developed,

developing, OECD, Asian, and beyond).

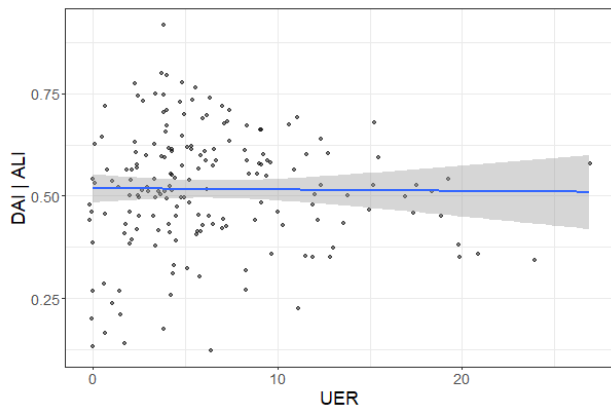


Fig. 10 Outcome of FIT regression line UER~ DAI with ALI as panel variable

9.4. H4: Digital adoption is positively influencing the personal remittance received

With a factor loading of 0.39, personal remittance received (PRR) emerges as an unlikely protagonist among the distinguished trio of influential factors. The result unveils an intriguing reality: PRR is positioned as a direct boon for migrants' homelands, underlined by its reversed nature. Yet, the truth remains that migrants channeling funds (represented by PRR, a percentage of GDP) back home contribute to the amelioration of their home country's prosperity, as emphasized by [31]. However, our study refrains from elucidating whether this advancement pertains to the migrants' social well-being or economic well-being, in line with the stance presented by [32]. Alternatively, PRR surfaces as an instrument that bolsters both economic and social well-being within the migrants' nations of origin. Significantly, social well-being is an integral component of sustainable development, adding a layer of complexity to the narrative. Turning to Figure 11, it becomes evident that PRR shares an indirect relationship with the digital adoption index (DAI), amplified through the incorporation of GDP as a mediator. The underlying implication unfolds: PRR serves as a tether linking economies less developed in the digital realm, compelling citizens from such economies to migrate towards more digitally advanced counterparts. This narrative, nestled within the intricate interplay between remittance and technological progress, signifies the confluence of financial well-being, migration dynamics, and digital evolution.

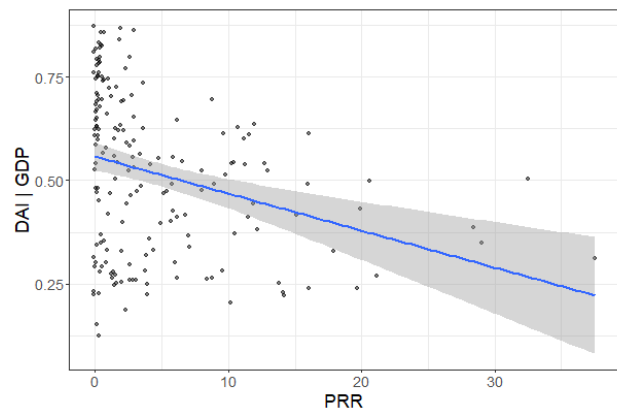


Fig. 11 Outcome of FIT regression line PRR~ DAI with GDP as panel variable

9.5. H5: Digital adoption is positively influencing research and development

Remarkably, research and development expenditure (RDE) surges forth as one of the premier influential factors, substantiated by its robust factor loading of 0.74. This outcome attests to the pivotal link between RDE and the digital adoption index (DAI), as the two factors align in a symbiotic dance of significance. Notably, technology's resounding impact on research and development finds resonance in the works of, [36] and [37], where it's affirmed that technological strides precipitate amplified investment in research and development. Moreover, the study underscores the pivotal role of RDE in fostering sustainable development, aligning with the perspective articulated by [38] through their discourse on "Goal: 9 Foster innovation". The essence of this proposition is that the embrace of technology paves the way for enhanced investment in research, technology, and innovation – an amalgam that serves as a potent catalyst for development. Figure 12 comes into the limelight as a testament to this interplay. It graphically demonstrates the direct proportionality between RDE and DAI, with the literacy index (ALI) seamlessly interposed as a mediator. This depiction reiterates that the fabric of economic sustainability isn't woven from the singular threads of technology adoption or investment alone. Rather, it's the synthesis of technology-driven growth, research-driven innovation, and the fabric of socio-economic development that truly propels nations towards enduring prosperity.

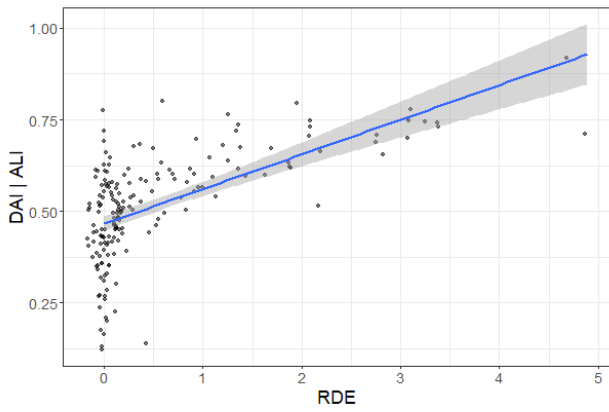


Fig. 12 Outcome of FIT regression line RDE~ DAI with ALI as panel variable

9.6. H6: Digital adoption is positively influencing the GDP growth

Astutely, the factor loading for Gross Domestic Product (GDP) emerges at 0.05, surpassing the realm of acceptability as outlined by Hus et al. (2017). This pronounced value is situated above the fixed parameter (DAI: 1.0), beckoning for comprehensive contemplation. Intriguingly, technology's imprint on GDP unfurls, underscored by significant negative implications. Noteworthy research by [44] highlights the phenomenon of technological entrepreneurship, while the linkage between technology and a rise in income. Such affirmative resonance between technology and GDP wields the potential to fuel sustainable development, thereby galvanizing economic growth and fostering social well-being – an alignment substantiated by [32]. For instance, delving into descriptive statistics unveils that Singapore's average DAI towers at 0.869, eclipsing the mean DAI of developed economies at 0.73. Notably, Singapore's annual GDP surges to 3.03, overshadowing the average annual GDP of 2.87 in developed economies. This juxtaposition augments as per descriptive statistics belief that technology-infused GDP

can catalyze economic prosperity and enhance societal welfare. Yet, Figure 13 evokes a divergent narrative. It captures GDP's regression as teetering on the brink of equilibrium, enmeshed in an intricate interplay with the mediating forces of ALI, RDE, and ACI. This vista, while initially perplexing, heralds the nuanced nature of GDP's relationship with the digital adoption index. It underscores the multifaceted dynamics at play, where the transformative potential of technology intermingles with the intricacies of various socio-economic variables. As we unravel this intricate web, we glean insights into the complex symphony that technology orchestrates in shaping the tapestry of economic advancement and societal well-being. The digital adoption with the mediating factor of literacy, research and development and alcoholic consumption shows clearly that GDP is not attributed. Further study is needed to look at these statistics for economies or even developed countries vs developing countries.

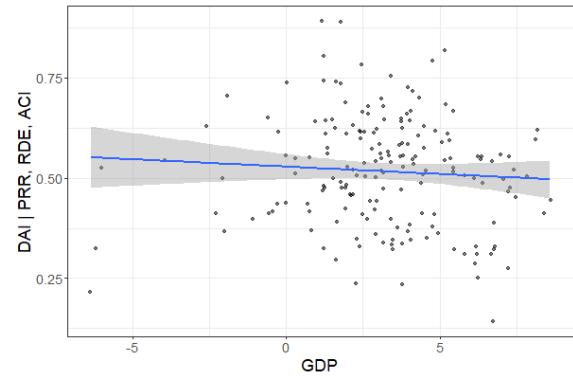


Fig. 13 Outcome of FIT regression line GDP~ DAI with ALI | RDE | ACI as panel variable

10. Conclusion and Implications

10.1. Conclusion

The summary of studies in Table 6 shows the significance from higher to lower order.

Table 6. Significance of factors in SDG development

Variable	Significance with digital adoption (DAI) Estimate/Std Estimate	Significance detail	Associated SDG goal
ALI	0.38	A positive correlation will bring social change in improving poverty, good education, women empowerment, and quality of life	Related to “Goal 3 (Equitable, and quality education)”
PRR	0.39	Neutral, but positive change as it brings sustainable economic growth in the home country, and not in the resident country (working location)	Related to “Goal: 9 (Sustainable economic growth)”

ACI	0.58	Significance but negative correlation as alcoholism brings negative sustainability. It affects health and social well-beings.	Related to “Goal: 3 (Health, and well-being)”
RDE	0.74	The positive correlation, will enhance scientific research, and improve sustainability from a foster innovation perspective	Related to “Goal: 9 (9.5) (Enhance scientific research)”
UER	0.003	A neutral correlation, DAI in the form of IT capital replaces labour. Negative sustainability. Satisfy goal 8 but dissatisfy employment rate	“Goal: 8 Productive employment, and decent work to all”
GDP	0.05	Non-significant loading. A negative correlation will bring negative wealth and social well-being	Related to Goal: 9 (Sustainable economic growth)

This paper represents a notable contribution by converging the multifaceted dimensions of Sustainable Development Goals (SDGs) with the realm of technological adoption. Our study, albeit focusing on a select set of parameters related to technology, education, and socio-economic factors, yields profound insights for policymakers, societies, and organizations alike. The depth of our analysis extends beyond the mere examination of variables; it casts a spotlight on the intricate interplay between technology and social factors such as unemployment, literacy, and alcohol consumption. By delving into these domains, our study presents a canvas of understanding, enriching the dialogue among stakeholders who shape policies and strategies. Furthermore, our exploration transcends the macro-level dynamics, delving into micro-level issues such as technology skillsets and digital adoption. This facet is crucial in navigating the turbulent waters of job disruption, characterized by the evolving role of technology that often supplants human involvement. As the economic landscape remains fluid, and technology continues to be a harbinger of change, the relevance of frequent studies becomes paramount. The importance of timely assessment cannot be overstated. A dynamic economic scenario, coupled with the relentless pace of technological disruption, necessitates vigilant monitoring. Frequent studies serve as a barometer, enabling us to discern shifts and anticipate uncertainties. This predictive ability, stemming from regular analyses, empowers policymakers to implement interventions with precision and timeliness. As we conclude this journey through the nexus of technology and sustainable development, it becomes apparent that the correlation between digital advancements and SDGs is a fluid concept. The very fabric of this relationship may evolve over time, warranting constant reevaluation. Our study, with its focused analysis, serves as a clarion call for perpetual vigilance, ensuring that the bridges we construct between technology and sustainable development remain responsive to the changing currents of our world. In essence, our paper stands not as a finality, but rather as a prologue to an

ongoing saga. The path forward invites us to continually adapt, recalibrate, and scrutinize, fostering a harmonious synergy between technology and the intricate tapestry of sustainable development.

10.2. Managerial Implications

10.2.1. Practical implication

The current study embarked on a journey to unravel the intricate correlation between digital adoption and the socio-economic variables underpinning sustainable development on a global canvas. However, as we traverse this path, a critical realization emerges – the need to plunge deeper into the labyrinthine landscape, unearthing regional disparities and nuances that may elude macro-level analyses. While this study has cast its net wide, encompassing a global vista, it's imperative to recognize that these macro-level findings might not seamlessly extrapolate to micro-level realities. The contours of impact often shift when zooming in on specific regions or individual economies. Hence, the journey does not culminate here; rather, it beckons us to undertake further exploration at a granular scale. Our primary data wellsprings are drawn from the annals of the World Bank data catalog [48], a repository teeming with invaluable insights. Yet, it's noteworthy that even amidst this wealth, some macro-level data within the SDG dataset stands incomplete or enigmatically absent. Notably, the construct of the Digital Adoption Index (DAI), while serving as a lodestar, is not without its complexities. The index's calculation, encapsulating the triad of "economy – people, government, and business," offers a lens to gauge digital adoption. However, its correspondence with direct measurements of digital adoption towards fostering sustainable development might be more intricate than envisioned. This brings us to a crossroads, where we discern the imperative for deeper exploration, region by region, and economy by economy. This endeavor mandates an ardent collection of localized data, crafting a tapestry of insights attuned to the specificity of each context. In essence, while our macro-level findings stand as signposts of promise, they

also underscore the broader canvases of exploration that beckon at the micro-level. In summation, this study serves as an inaugural foray into the nexus between digital adoption and sustainable development. As we broaden our horizons, the implications transcend beyond statistical analyses, steering us toward the intricate interplay of diverse socio-economic landscapes across the globe.

10.2.2. Theoretical implication

Our study carries profound theoretical implications, unveiling the nuanced intricacies underlying the measurement of digital adoption in the landscape of constant dynamism. In this era of ceaseless transformation, the relevance of gauging digital adoption's facets may transcend the temporal confines of conventional measurement. Intriguingly, the dimensions and metrics that underpin each factor in our study diverge, weaving a complex tapestry of insights. A case in point lies in the juxtaposition of indices such as Digital Adoption Index (DAI) and Adult Literacy Index (ALI), which are confined to a bounded range of 0 to 1. Contrastingly, the terrain shifts when examining metrics like Gross Domestic Product (GDP), Unemployment Rate (UER), Personal Remittance Received (PRR), and Research and Development Expenditure (RDE), spanning a spectrum from 0 to 11. The lens of digital adoption merely grazes the edges of a more profound phenomenon - digital disruption. Operating as a gentle undertow on the macro-level, it reshapes the very foundations of industries, products, and services. Yet, this disruption wields a varying impact, dependent on the economic ecosystem it encounters. In this light, our study provides a preliminary glance at a subset of Sustainable Development Goals (SDGs), beckoning us toward more elaborate explorations. A pathway to richer insights unfolds, beckoning us to venture deeper with a focused lens. We propose a linear regression framework, wielding one dependent variable and a chosen independent variable, accompanied by others as mediators. This micro-level scrutiny could elucidate the direct and indirect impacts of technology, delineated by regional and economic nuances. The landscape of digital disruption is intricate and diverse; our study, a mere prologue, invites future researchers to embark on the journey of understanding it in granular detail. In summation, our study hints at the broader phenomenon of digital disruption, underscoring its heterogeneous impact across diverse economies. While the digital adoption metric initiates the conversation, the trajectory of understanding pivots toward comprehensive linear regression, fostering insights into the direct and mediated effects of technology on a micro-level spectrum.

10.2.3. Societal implication

The variables under scrutiny in our paper - literacy, alcohol consumption, and unemployment - although analyzed on a macro-level, are imbued with intricate micro-level

variations that transcend the overarching economic landscape. It is imperative to acknowledge that these social factors are far from uniform even within an economy. The complexity emerges as we traverse from the macro to the micro, realizing that the application of overarching results may not seamlessly translate to individual economies. Within the mosaic of economies, literacy, alcohol consumption, and unemployment exhibit divergent profiles, interwoven with unique policies and nuances. The aggregate macro-level analysis, while shedding light on certain trends, does not hold the key to a direct application at the micro-level within economies. Each economy boasts a distinct representation of these social factors, colored by region-specific policies and socio-economic dynamics. Indeed, some variables, like alcohol consumption, unveil a statistical significance in our study. However, this significance is shrouded in negative implications. The prominence of Alcohol Consumption Index (ACI) at 12.15 signifies an intricate interplay. While technology might amplify the consumption of alcohol, it inadvertently fosters a breeding ground for social issues. The nexus between technology and alcoholism is complex, an intricate dance between access to information and the unearthing of social challenges. Our study unfurls a path for future research, beckoning scholars to embark on region-specific explorations. This nuanced trajectory delves into the heart of each region, recognizing that the micro-level intricacies necessitate bespoke analyses. It is within the realm of these individual economies that the true tapestry of literacy, alcohol consumption, and unemployment reveals itself. In essence, our study serves as a preliminary step, unveiling the macro-level trends that envelop social factors. It extends an invitation to researchers to delve deeper, exploring micro-level nuances within each region and economy. As we navigate this uncharted territory, we are poised to unravel the complex web of socio-economic dynamics that shape these factors, ultimately guiding the formulation of tailored policies and strategies.

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Not Applicable.

Author contributions

Radhakrishnan Subramaniam 1: Entire paper including data collection and analysis. **Prashobhan Plakkeel 2:** Verified data and data analysis. **Manimuthu Arunmozhi 3:** Method, methodology, results and discussion. **Manikandan S 4:** Scope, literature background.

Conflicts of interest

The authors declare no conflicts of interest.

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