IMPACT OF FINANCIAL INNOVATION ON SUSTAINABLE ECONOMIC DEVELOPMENT: A CROSS COUNTRY ANALYSIS

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NATIONAL UNIVERSITY OF MODERN LANGUAGES ISLAMABAD

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LIST OF ABBREVIATIONS

SED	Sustainable Economic Development
FI	Financial Innovation
FD	Financial Development
ICT	Information & Communication Technology
REC	Renewable Energy Consumption
EG	Economic Growth
FDI	Foreign Direct Investment
APD	Aging Population Dependency
NRA	Natural Resource Abundance
INT	International Tourism
TOR	Trade Openness

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Abstract:

Financial innovation holds the potential to drive the economic growth, enhance resource allocation efficiency, and foster entrepreneurship. Innovations such as fintech platforms, block-chain technology, and impact investing have been considered as transformative tools that can unlock new sources of capital, facilitate inclusive financial access, and promote environmentally sustainable practices and sustainable economic development (SED). Keeping in view the significance of financial innovation, this research examines the impact of financial development, renewable energy consumption, and information and communication technology (ICT) on sustainable economic development on selected developing countries. This research focused on panel data analysis ranging from 1990 to 2022, to investigate the sustainable economic development in selected countries. For the empirical analysis, Generalized Method of Movements (GMM) is applied; it has efficiency to resolve the presence of serial correlation. Based on empirics, this research found positive and significant impact of financial innovation on sustainable economic development across selected countries. Furthermore, it is concluded that factor such as financial development, renewable energy consumption, and information & communication technology, international tourism, trade openness, foreign direct investment exert positive and significant impact on sustainable economic development. However, this research identified that natural resource abundance and aging population dependency variables have negative and significant effect on SED. Drawing from analysis results, this research suggested that Financial Institutes should devise regulatory frameworks and hybrid models to support financial innovation through new financial products, digital banking, fintech solutions, and services. Central Banks in selected countries should prioritize strategies that enhance financial development, increase the availability of financial resources, and ensure efficient mechanisms for directing capital towards impactful industries. Moreover, ministry of telecommunication and IT should build a comprehensive ICT infrastructure in order to ensure widespread broadband access, and reducing financial barriers through incentives and also focus on strengthening institutional capacity and establishing well-defined regulatory frameworks within the energy sector.

Key words: Financial Innovation, Financial Development, Renewable Energy Consumption, Information and Communication Technology (ICT), Sustainable Economic Development

CHAPTER 1

1. INTRODUCTION

The global society continues to grapple with multifaceted problems in the social, environmental, and economic domains, limiting the rate of global economic recovery. Furthermore, epidemic's effects have resonated throughout nations, aggravating financial restrictions and amplifying sustainability concerns. The outbreak has caused significant harm to economies around the world, worsening financial restrictions and issues related to sustainability. In accordance with The World Bank Report, global economic production was sharply declined to 1.7 percent in financial year 2023 (Global Economic Prospects, 2023). This setback has underscored the urgent need to promote sustained, inclusive, and sustainable economic growth (SDG 8) (Danladi et al., 2023).

The functioning of financial systems is crucial for enabling economic activity, distributing resources, and managing risks, therefore innovations in this area have the potential to alter the overall trajectory of economic progress and development. A resilient and robust monetary system forms the cornerstone of a vibrant economy, comprising financial institutions, varied markets, methods, and processes that facilitate the global exchange of securities and services thereby driving the modernization and fortification of the economy's financial infrastructure. The financial system is more than just monetary transactions; it is a major conduit inside the complicated fabric of modern society, intertwined with the economic apparatus and playing a critical function within the larger social context. In an age of rapid technological improvement and worldwide economic interconnectedness, financial innovation boosts economic growth by increasing financial presence, reducing financial procedures in global trade, and enhancing financial competence.

Innovation in financial system in underdeveloped nations indicates potential of growth in financial sector. During the previous twenty years, nations across Asia have witnessed major financial advances, notably in the financial sector, aimed at promoting financial development. This includes the formation of non-banking financial entities focused on providing financial lending to support investments. The financial industry in developing nations currently includes a

wide range of entities, including leasing institutions, insurance companies, commercial banks, and specialized financial entities including financial markets, housing financing corporations, and informal financial enterprises. These developments show a dynamic change in the financial landscape, helping to expand and diversify financial services in Asian countries and, ultimately, play a pivotal role in promoting regional economic advancement (Loukoianova et al., 2018).

Financial development acts as a cornerstone for achieving economic sustainability in both developed and developing nations. A well-structured and robust financial system plays a critical role in stabilizing the money market. This is achieved through mechanisms like controlling the money supply and managing other financial instruments. This stability fosters an environment conducive to industrialization, which ultimately translates to accelerated economic growth. But financial development's contribution goes beyond just basic stability. Nabeeh et al. (2021) aptly describe the financial system as a catalyst, working in tandem with both fiscal and monetary policies to propel sustainable development. Fiscal policy, encompassing government spending and taxation, can be leveraged to incentivize investments in clean technologies and renewable energy. Monetary policy, on the other hand, influences interest rates, impacting borrowing costs for businesses and individuals. By lowering interest rates, central banks can encourage investments in sustainable projects. A well-developed financial system acts as the engine that allows these policies to reach their full potential. It facilitates the efficient allocation of financial resources towards sustainable endeavors, ensuring that capital reaches businesses and individuals who are driving the transition towards a more sustainable future. This collaborative effort between financial development, fiscal policy, and monetary policy is essential for achieving long-term economic sustainability.

Financial development is critical for developing economies. A well-developed financial system enables enterprises to expand operations, and generate job opportunities, and promotes financial inclusion by making savings accounts, credit, insurance, and payment systems more accessible to marginalized communities. Therefore FD holds significance in encouraging economic activity and promoting social and economic growth. FD has a greater effect on per capita GDP when the financial sector is incorporated into a strong institutional framework. Furthermore, financial development has the greatest impact in middle-income nations, where its advantages are particularly potent under conditions of high institutional quality. Importantly,

research demonstrate that financial development has the least influence in low-income nations; in these countries, greater finance without strong institutions may fail to offer long-term economic advantages (Baliamoune-Lutz, 2010).

The energy sector holds immense influence over the sustainability of economies. The current reliance on non-renewable energy sources comes at a hefty price environmental degradation. This relentless exploitation of natural resources not only disrupts ecosystems but also presents serious economic challenges. The long-term costs associated with pollution clean-up, resource depletion, and climate change can significantly burden national economies. Embracing renewable sources like solar, wind, and geothermal power offers a path towards environmental protection and reduced energy inefficiency. These clean energy sources contribute to climatic sustainability, mitigating the harmful effects of greenhouse gas emissions and climate change. This, in turn, fosters a more stable and predictable economic environment. However, the transition requires a sense of urgency. The global energy consumption demand is projected to rise by a staggering 48% by 2040, according to the International Energy Outlook (2016). Meeting this demand with sustainable solutions necessitates a significant shift in energy production and consumption patterns. Investing in renewable energy infrastructure, incentivizing clean energy adoption, and promoting energy efficiency measures are all crucial steps towards a more sustainable future.

While developments in information and communication technologies (ICT) account for around 2 percent of worldwide CO2 emissions, inflicting environmental damage (Ulucak & Khan, 2020), they also have enormous promise as a driver of efficient energy utilization. Harnessing this potential can lead to increased economic output and, eventually, development. However, the current situation presents a confusing picture. Developing countries confront a formidable challenge: balancing excessive energy use, a lack of renewable energy options, and environmental deterioration while adhering to tight budgetary limits (Atsu et al., 2021). Therefore, harnessing the good side of ICT demands a systematic approach. Investing in green technology, increasing digitalization in energy sectors, and encouraging sustainable practices within the ICT industry are all critical initiatives. By assuring responsible development and prioritizing renewable energy sources, we can transform the ICT revolution into a driving force for both expansion of economy and preservation of environment.

ICT adoption presents a win for achieving SED in emerging nations. Firstly, it offers a path towards environmental sustainability by reducing energy consumption and environmental degradation. Paperless transactions facilitated by online banking and e-commerce platforms decrease reliance on physical resources like paper and fuel for transportation. Additionally, ICT empowers businesses to optimize logistics and production processes, minimizing waste. Secondly, as Fu et al. (2021) highlight, renewable energy consumption can significantly contribute to SED in emerging economies. Smart grid technologies, for instance, leverage ICT to optimize energy distribution and integrate renewable energy sources into the grid more effectively. Furthermore, research by Ruan et al. (2022) suggests that economic resource utilization shifts towards digital technologies like online banking and e-commerce. This digital shift enhances resource efficiency, allowing emerging economies to gain a comparative advantage in a globalized marketplace focused on sustainability.

Information technologies have revolutionized financial accessibility and economic convenience. However, their impact on energy consumption presents a complex picture. Empirical studies like Coroama et al. (2013) highlight the positive aspects, suggesting that ICT advancements can be key drivers of economic success. They argue that ICT fosters higher productivity and product quality while minimizing energy consumption. This suggests that technological advancements can decouple economic growth from environmental impact. However, Lu (2018) presents a contrasting viewpoint, concluding that ICT contributes to increased energy consumption alongside economic output. This potential drawback underscores the need for a nuanced approach. By promoting energy-efficient technologies and data center practices, we can harness the power of ICT for economic growth while mitigating its environmental footprint.

1.1. Problem Statement

Since the industrial revolution, emerging economies have encountered persistent challenges such as financial crisis, energy shortage, climate change, and extensive expansion of technology, all of which must be addressed to attain SED. The modern global landscape is witnessing the convergence of different elements that profoundly influence the direction of long-term economic development, with developing countries playing a critical role in this transformation. Financial innovation is the significant channel to develop better financial

policies, financial products, financial access, and advanced technology to mitigate carbon emissions and improve economic standing (Shobande & Shodipe, 2019). Despite the potential benefits of financial innovation for fostering inclusive growth, improving resource efficiency, and mitigating systemic risks, its adoption and implementation in developing country contexts are frequently constrained by a myriad of socioeconomic, regulatory, and institutional constraints. Limited access to financial services, limited infrastructure, weak regulatory frameworks, and institutional capacity limits all represent substantial barriers to leveraging financial innovation's transformative potential for long-term economic development in developing countries. Moreover, developing nations are struggling to access foreign loans and foreign direct investments to develop advanced technologies and enable energy transition. Financial development in developing countries faces a complex hurdle such as a large portion of the population lacks access to formal financial services leading them to rely on informal financial sector. This, coupled with weak financial infrastructure and vulnerability to external shocks, creates a situation where financial exclusion and instability hinder economic growth. Moreover, energy consumption is the vital element in economic growth but has long run implications on the environment and biodiversity. Whereas, developing nations face numerous challenges in ramping up renewable energy consumption including high upfront costs for infrastructure and technology, lack of skilled labor, dependence on traditional energy sources for revenue and established energy grids that may not be compatible with renewables. Developing countries are also struggle in adopting ICT. Lack of infrastructure, especially in remote areas, limits internet access and hinders technology use. Furthermore, the high cost of devices like computers and smartphones can be a barrier for many citizens.

In the pursuit of long-term economic growth, it is imperative to investigate deeply into the complex interconnections among financial innovation, financial development, renewable energy consumption, and ICT; as such factors are crucial for SED in developing countries.

1.2. Research Gap

Existing research frequently focuses on individual components of financial innovation, financial development, renewable energy, socioeconomic indicators or ICT and their discrete effects on economic sustainability within particular nations or areas (Jalil et al., 2018; Wang et al., 2019; Hunjra et al., 2022). Recent studies have investigated that the FD has a notable positive

and significant influence on the growth of the economy. (Nguyen et al., 2019; Jedidia et al., 2014; Pradhan et al., 2017; Ali et al., 2022; Hunjra et al., 2021; Afonso & Blanco-Arana, 2022) despite some contradictory views (Mukhopadhyay, et al., 2011; Boikos et al., 2022). Furthermore, Cheng Lu (2014) investigated the correlation among ICT, energy consumption, FD, economic growth and emissions of CO2, and found that ICT and FD are essential tools for economic development.

Furthermore, previous researchers have predominantly emphasized economic growth as the primary measure of productivity of the nations, rather than the broader concept of SED which encompasses environmental and social well-being alongside economic prosperity. Additionally, many existing studies have been confined to specific geographical areas or individual countries. A significant research gap exists in exploring the comprehensive effect of various factors on SED in developing nations. As these nations are a diverse group, facing unique challenges and opportunities. Studying the specific context of these countries is crucial. These gaps in the literature underscore the need for more holistic examination of the interrelated dynamics of these components in the context of sustainable development framework in developing countries.

Considering the gaps in the previous literature this research examines the impact of financial innovation, financial development, ICT, REC, international trade, tourism, aging population, natural resource abundance and FDI on SED. A comprehensive cross-country analysis is required to investigate how these variables interact and effect economic sustainability across various nations.

1.3. Objectives of the study

Limited evidence in existing body of literature regarding the significance of FD, ICT and REC on the growth of the economy in developing nations paved the way for the extensive study (Hunjra et al., 2022).The developing countries are still facing major challenges including financial instability, climatic vulnerability, poor financial system, production inefficiency, and lacking innovative technology which directed to lower the steady state economic development in long term.

The research objectives are as follows:

I.   To analyze the impact of financial innovation on sustainable economic development.

II.   To analyze the impact of financial development on sustainable economic development.

III. To analyze the effect of renewable energy consumption on sustainable economic development.

IV.   To analyze the effect of information & communication technology on sustainable economic development in diverse nations.

V.   To investigate the impact of socioeconomic variables on sustainable economic development.

1.4.   Research Questions

RQ- I: How financial innovation impacts SED in a cross country context?

RQ-II: How financial development effects SED?

RQ-III: How does the renewable energy consumption impacts SED?

RQ-IV: How information & communication technology impacts SED?

RQ-V: How socioeconomic variables effects SED?

1.5.   Significance of the Study

The research has profound implications for stakeholders including policy-makers and academia. The significance of this research is important as it provides valuable insights for policymakers in developing countries. This research delves into the interconnected dynamics of FI, FD, REC, and ICT as pivotal elements in the pursuit of economic sustainability. SED offers a more promising path forward, promoting poverty reduction, environmental protection, social equity, resilience, and the ability to attract investment. By embracing this approach, developing countries can build a more prosperous and sustainable future for their citizens. Through designing effective policies, governments in developing countries can also contribute to achieving the global objectives outlined in the SDGs (United Nations, 2015).

Moreover, it is important for developing countries to achieve sustainability in economic development without compromising environmental or social well-being. This research

recognizes the interdependence of these components and acknowledges that progress in one area can significantly influence outcomes on others. This research explores the essential role of robust financial systems, innovative practices, and sustainable approaches in fostering equitable and sustainable economic development. The outcomes can help policy makers to identify untapped potential for synergy between FI, FD, REC, ICT, and socioeconomic variables.

Secondly, this research can contribute to the theoretical understanding of interaction among the various factors and their influence on SED. This research collectively examines the interplay between FI, FD, REC, ICT, socioeconomic variables and the research shed light on previously unexplored dynamics within the broader field of sustainable development. This can lead to the development of new theoretical frameworks and models that better capture the complexities of achieving SED in developing countries. And finally, the paper focuses on very wide observations by investigating a panel of developing countries between 1990 and 2022, which provides the holistic view of the correlation between finance and growth

CHAPTER 2

2. LITERATURE REVIEW

2.1. Financial Innovation

FI is defined as the formulation of new financial entities, products, and payment methods (Gorton, 1992), an efficient method of enhancing profit, a reduction in financial transaction expenses, and the implementation of updated regulatory reforms (McGuire & Conroy, 2013) for long-term FD. Beside the creation of new products the innovation serves as solutions to economic problems. Financial innovation improves capital allocation, enhances the value of financial product and service, expand more efficient and stronger financial markets and boost the efficiency and effectiveness of financial organizations (Allen, 2011; Uddin, Rahman, & Quaosar, 2014). As a result, the effectiveness of financial institutions influences financial development by improving transaction methods that facilitate both international and domestic trade. Improved financial services and development of stock market is a product of diverse development in financial system because of financial innovation (Simiyu & Ngugi, 2014; McGuire & Conroy, 2013) with ultimately results in exports-led economic growth (Jawaid & Waheed, 2018). All of the advances contribute to expanding the economy by involving individuals in the procedure of economic development.

Schumpeter (1934) claimed that innovation in financial sector, including the invention of new financial tools and intermediaries, drives entrepreneurial activity and promotes economic progress. Afterwards, financial innovation constitutes an essential component of rising activities in the economy and is viewed as the driver of financial expansion in actual economic activity. Recently, it is estimated that globally more than 1.7 billion of adults, predominantly from the most impoverished regions, lacking access to formal financial services such as they are excluded from the banking system. To foster economic activities and eliminate poverty, alongside various other social targets, efficient solutions should be devised globally to enhance and strengthen financial inclusion. The core of this approach is prioritizing the elements that creates or disrupts connections, as well as the challenges within this intricate process. The constraints encompass hindrances of infrastructure and facilities, such as the availability of the branches of the banks, including the social and cultural factors that impede access for certain groups based on literacy,

race, sexuality, and gender, alongside risk aversion stemming from inadequate financial resources (Daud & Ahmed, 2023).

This positive impact manifests through several channels. FI stimulates economic activity by boosting financial inclusion. By creating new financial products and services, FI empowers previously unbanked populations to participate in the formal economy. This can involve mobile banking solutions, microfinancing options, or innovative insurance products tailored to specific needs. Increased financial inclusion translates to greater access to credit and financial resources, fueling entrepreneurial ventures, small business growth, and ultimately, economic activity. FI facilitates financial international trade transactions. Innovative financial instruments like letters of credit and secure online payment systems reduce the risks and costs associated with international trade. This promotes cross-border commerce, fostering economic activity in both importing and exporting nations. Moreover, FI enables remittances, a crucial source of income for developing countries. New technologies like blockchain-based remittance platforms offer faster, cheaper, and more secure ways for migrant workers to send money back home. This financial lifeline supports families and local economies in developing nations. The benefits of FI extend beyond these direct contributions to economic activity. As Napier (2014), highlights in the context of Bangladesh, FI acts as a catalyst for fostering financial development itself. By diversifying financial services (Silve & Plekhanov 2014) and enabling more effective financial intermediation (Johnson & Kwak 2012), FI creates a more robust and inclusive financial system. Technological advancements in areas like credit scoring (Michalopoulos et al., 2011) further enhance this efficiency. Ultimately, FI serves as a novel mechanism to optimize resource allocation, maximizing productive output and contributing to sustainable economic development (Sood & Ranjan 2015).

Financial innovation is the pivotal component of economic movements. It has manifested in operational shifts within the system, leading to advancements in services and improvements in payment structures. Innovation drives operational adjustments, which streamline existing systems and pave the path for improved services and payment arrangements. Consider the rise of mobile banking, which eliminates traditional brick-and-mortar limits while increasing financial inclusion and convenience (Michalopoulos et al., 2011). Innovation encourages the creation of whole new markets and organizations. Simiyu (2014) cite crowd funding sites as an example of

how businesses can engage with investors outside of traditional channels. These new actors diversify the financial environment, releasing hitherto untapped resources and accelerating economic growth. Moreover, Government legislation must be updated to reflect innovation. As Chou and Chin (2011) point out, authorities must constantly examine and modify regulatory frameworks to accommodate new financial products and services while maintaining stability. Similarly, Mwinzi (2014) underlines the importance of public opinion in influencing these policies, ensuring that financial innovation serves a larger societal good. Finally, financial innovation is more than just a technological advancement; it is a potent force that shapes the very structure of economies. From operational efficiencies to the creation of new markets, its reach goes far beyond financial institutions, influencing governments, enterprises, and individuals alike. Understanding its various expressions allows us to better leverage its potential to achieve inclusive and sustainable economic growth.

Financial innovation promotes economic sustainability by not just increasing financial market productivity but also encouraging capital growth, refining financial services, and facilitating more effective financial intermediation. Innovative financial mechanisms and technology have a revolutionary influence on the efficiency and accessibility of financial services, contributing to a more equal economic landscape. Financial product diversification, such as the introduction of fintech solutions and block chain technology, has the potential to streamline procedures, lower transaction costs, and improve overall market liquidity (Gerged, 2022). Furthermore, by introducing novel funding arrangements and risk-sharing instruments, financial innovation has a proven impact on capital development, promoting investment and entrepreneurship. This not only helps established businesses develop, but it also fosters the formation of new ventures, contributing to economic dynamism. Furthermore, the growth of financial intermediation through technologies such as digital banking and alternative lending platforms allows a greater segment of the population to access money, promoting financial inclusion and lowering wealth distribution gaps. As the study delves into the complex consequences of financial innovation, it sheds light on the diverse economic performances associated with various techniques of innovation, emphasizing the significance of selecting approaches that correspond with sustainability objectives. This is strengthened further by the recent finding that increased banking efficiency driven by financial innovation and competition can promote growth and development of economies (Ajide, 2016). Another research presents

fintech's impact on long-term climate and a societal goal underlining both positive as well as negative consequences. On the plus side, FinTech developments have the potential to promote environmentally friendly financial practices, so advancing sustainability. Digital payment systems and block chain technologies can improve supply chain transparency, allowing businesses to trace and verify sustainable practices. Furthermore, FinTech promotes financial inclusion by making formerly underprivileged groups more accessible and inexpensive, so contributing to social fairness. The emergence of FinTech, on the other hand, offers challenges to established banking methods, creating new competitors and transforming the financial services market. Neobanks, distinguished by their digital-first strategy, are a disruptive force that challenges traditional banking institutions while stressing user-centric services (Pawlowska, 2022).

The effectiveness of the relationship is based on a system's ability to ensure the allocation of economic resources efficiently. There is a broad agreement that both financial and technological changes are inevitable and tend to evolve over time. Financial innovation provides a channel for investing in high-tech projects when conventional resources are inaccessible due to associated risks. Whereas, the convergence of high technological and economic development results in increased complexity in business practices. Financial markets adapt to these changes by introducing various risk factors and restructuring themselves to meet market demands. This underscores the significance of financial innovations in preventing a slowdown in high-tech and economic progress, while simultaneously enhancing the wealth of nations. Such innovations introduce and endorse improved financial organizations, tools, and technologies into this system (Sood & Ranjan, 2015). A contemporary economy necessitates a well-structured financial system comprising financial markets, instruments, regulations, and institutions. The efficacy of financial intermediation in fostering activities of the economy is furnishing sufficient financial services in trade and mitigating the risk associated with investment through diversification (Shittu, 2012; Cheng & Degryse, 2014). The active system sustains growth by reorganizing finances in the economy in an efficient and suitable manner. Continuous innovation is the product of a well-organized system (Blair, 2011), which pave the ways for the creation of numerous institutions, particularly banking systems with more effective financial and apparatuses, liquidity, and credit services, demonstrating enhanced development in the economy (Jedidia et al., 2014).

The quest of technological advances that can improve financial intermediaries' ability to evaluate and select business organizations is one of the key motivators pushing them to engage in innovation activities. This technical advancement is intended not just at increasing business profitability but also at maintaining an industry competitive edge (Laeven et al., 2015). As per accordance with the previous literature, FI can play a critical role in stimulating technical developments. It accomplishes this by increasing financial intermediaries' ability to assess and process information, hence lowering information asymmetry (Petersen & Rajan, 2002). Lerner and Tufano (2011) demonstrated how FI can benefit biotech start-ups by allowing them to access more finance at a lower cost. Furthermore, Frame et al. (2016) discovered that implementing credit rating systems in SME can positively and significantly enhance financing availability to small and medium-sized firms, particularly those with a proclivity for innovation, particularly in low- and middle-income nations. Chang et al. (2019) investigated the impact of credit default swaps (CDS) on enterprises' technical advancement using CDS as a sample example of FI. Their findings show that CDS instruments can increase financial intermediaries' willingness to lend for innovative initiatives, hence promoting enterprises' innovation efforts. In essence, financial innovation acts not only as a catalyst for technological progress, but also as a facilitator for enterprises to improve their innovative capacities and promote economic growth.

Innovation in financial products and advancement in financial services played a crucial role within an economic system, with the potential to stagnated economic development if financial innovation comes to a standstill (Laeven et al., 2015). It has been witnessed that increasing adoption of financial innovation had impacted the banks' performance (Chen et al., 2020). Recent technical breakthroughs connected with mobile phones and internet connectivity has revolutionized the banking and financial services, making them more cost-effective and user-friendly, particularly at the consumer and retail level. As a result, customized and specialized financial products have become more affordable and convenient. These financial services and products have an impact on the economy due to their connectedness, affordability, and convenience, as well as the growth of the banking channel and its performance. By utilizing technological improvements in the financial institutes would empower farmers, the poor, the elderly, women, and underserved clients with low-cost access to investment options that generate income and financial tools to manage fluctuations in income (Daud & Ahmed, 2023).

With the advancement of technology, banks are expected to match themselves with the increased expectations of clients, who now anticipate the seamless experiences provided by technology suppliers. The banking system is on the verge of a disruption, according to the World Economic Forum in 2015. Disruption will be the constant force in the near future force that necessitates innovation. This will have a substantial impact on customer behavior, redefine company models, and transform the financial services sector's long-standing structure. Researchers have discovered three key characteristics via which financial innovation helps to the economy in the financial literature. To begin, FI is critical to boosting economic activity. This is accomplished by promoting financial inclusion, facilitating international commercial transactions, facilitating remittances, and improving overall financial efficiency. Second, the theory that links financial advancement and growth contends that the enhancement of financial products and services' quality is a result of financial innovation (McGuire & Conroy 2013). As a result, the financial development process moves more quickly, capital accumulation and allocation improves, and operating efficiency in financial organizations improves. Thirdly, FI, especially the expansion of institutions within the financial system, streamlines the financial activities by broadening access to established financial services like internet and mobile banking. Hybrid organizational forms, microfinance institutions, and non-governmental organizations are also included. The establishment of such organizations and services helps to enhance economic development by integrating the large portion of the population into the core economic growth process (Qamruzzaman & Wei, 2019).

H1: There is positive significant impact of financial innovation on sustainable economic development.

2.2. Financial Development

FD refers to the enhancement and maturation of financial institutions within an economic system. This progress is visible in two key indicators: the degree of liquidity in the economy and the growing breadth of the financial service industries. To begin, the expansion of financial institutions includes the formation, proliferation, and refining of various financial entities such as banks, investment firms, and other intermediaries. The growth of these institutions reflects a more complex and sophisticated financial landscape. Second, liquidity, a critical feature of financial development, refers to the ease with which assets can be traded in the market without

experiencing major price swings. A developed financial system has increased liquidity levels, indicating well-functioning markets and the ready availability of tradable financial instruments (Sawyer, 2015). The importance of financial entities and associated service industries indicates the stabilization in the society and the actual economy. The financial sectors are crucial to eliminating the financial crisis and other pandemic conditions, but only if sufficient liquidity is maintained by the country. Prior strategies were centered on making profitable investments, whereas for the economic development the subsequent approaches were focused on the financial resources. Financial development affects a company's capacity for investment (Hou et al., 2014).

Financial innovation paves the ways for financial development, including the expansion of the banking sector and financial market. Innovation sets the path for a more developed financial market and banking industry. New tools such as derivatives, exchange-traded funds, and peer-to-peer lending platforms broaden investment opportunities and make previously unavailable cash available. This, according to Ndako (2010), fuels a healthy market and banking sector, both of which are critical foundations of economic growth. Furthermore, it also promotes long-term economic progress by developing a strong capital market and financial institutions. Adusei (2013) emphasizes their importance in promoting lucrative investments, which are essential for long-term progress. By redirecting savings into productive endeavors, innovation uncovers previously untapped potential, quickening the development engine. However, the relationship is not one-sided. According to Uddin and Chakraborty (2009), financial development thrives in good economic conditions. A stable and developing economy draws investment and motivates financial institutions to innovate and thrive. This produces a virtuous cycle in which financial innovation drives the growth in the economy, which in turn encourages additional FD, resulting in increasing access to institutional finance for both individuals and corporations. The correlation between FI and FD is complex. While innovation clearly provides tremendous tools for economic improvement, its success is dependent on a fertile foundation of economic stability and expansion. Recognizing this complicated dance is critical for releasing innovation's full potential and creating a prosperous future for everybody. The financial sectors' "breadth and depth," as Paun et al. (2019) aptly describe it, translates into several advantages. Firstly, it lowers the cost of capital. Increased competition among financial institutions drives down interest rates on loans, making it more affordable for businesses to access the capital they need for growth and innovation. Secondly, transaction costs associated with financial services

are reduced, streamlining the investment process. Finally, a well-developed financial system facilitates better risk sharing through mechanisms like insurance and derivatives. This allows entrepreneurs and investors to manage risk more effectively, fostering a more conducive environment for investment. The historical evidence overwhelmingly supports this connection between financial development and economic growth. Countries with advanced financial systems, characterized by robust banking infrastructures and dynamic stock markets, have consistently demonstrated faster growth trajectories compared to those with underdeveloped financial sectors.

The effects of FD on the advancement and expansion of economies have been thoroughly investigated in academic studies, and despite certain counterarguments, the relationship between FD and EG has gained widespread recognition. Moreover, the finance industry primarily influences investment decisions, savings rates, and technical innovation (Levine, 2005). FD stimulates economic growth by gathering and collecting funds and directing these pooled resources to organizations that are projected to produce positive economic outcomes (Beck & Levine, 2004). Convergent, micro- and macro-prudential policies are critical for sustainable economic development because they allocate money to transforming the structure to foster green communities. Considering the importance of regulatory reforms and policies for SED, certain researches have undertaken a critical evaluation of the function of FD via transmission channels for monetary policy. (Ishiwata & Yokomatsu, 2018; Dafermos et al., 2018) financial rules contribute efficiently to controlling distortion of physical resource and limiting any detrimental influence on SED. A strong financial system, defined by well-functioning banks, capital markets, and efficient intermediation processes, is thought to greatly contribute to economic development by enhancing resource allocation and eliminating information asymmetries. Some academics suggest that, while financial development is a growth driver, its impact on sustainability is dependent on the quality and structure of financial institutions as well as regulatory frameworks. Financial inclusion, risk management, and the avoidance of speculative bubbles all become key factors in determining the long-term viability of economic progress (Venables, 2016).

Extensive empirical and theoretical research has explored the intricate connection between Financial Development (FD) and economic development. Underpinning this relationship is a theoretical framework built upon the foundational works of Schumpeter (1934),

McKinnon (1973), and Shaw (1973). Schumpeter (1934) laid the groundwork by positing the crucial role of financial services in fostering economic growth. He argued that a well-developed financial system acts as the lifeblood of innovation and entrepreneurship. By facilitating access to capital, financial institutions empower businesses to invest in new ideas, technologies, and production processes. This fuels innovation and drives economic growth.

McKinnon (1973) and Shaw (1973) further elaborated on Schumpeter's ideas, emphasizing the specific circumstances under which the financial sector can act as a catalyst for economic development. They argued that financial development is most effective when accompanied by financial deepening, which refers to an increase in the variety and complexity of financial instruments offered. This diversification allows financial institutions to better cater to the needs of different businesses and sectors, leading to more efficient allocation of capital and ultimately, faster economic growth (Chow & Fung, 2011; Pradhan et al., 2017). Theories built upon these foundational works have been extensively tested and refined through empirical studies. These studies have provided strong evidence supporting the positive correlation between FD and EG, solidifying the importance of a robust financial system for achieving SED.

A recent study by Haque (2020) delves into the connection between financial development (FD) and the growth of private enterprises. Their research sheds light on the multifaceted ways FD contributes to economic expansion. The study found that FD has a positive and statistically significant influence on overall economic growth, trade openness, and government spending. Interestingly, the results revealed a negative correlation between private sector GDP and money supply. This suggests that simply increasing the money supply may not necessarily translate to private sector growth. On the other hand, a positive correlation was observed between private sector GDP and credit extended to the private sector, albeit not statistically significant. This indicates that access to credit plays a role in private enterprise growth, but further investigation may be needed to solidify this connection. The study's findings regarding stock market capitalization were inconclusive. Haque (2020) research aligns with the work of Bist (2018) who employed econometric models to examine the relationship between FD and economic development in low-income countries. The research findings provide evidence of a co-integrating association between these variables, implying that they move together in the long term. This co-movement suggests that FD has a significant and positive influence on

economic growth over time. Further research into the money supply-growth nexus is provided by Rahman et al. (2020), who specifically investigated the correlation between money supply and economic growth in Pakistan from 1980 to 2017. Their work complements Haque (2020) findings by highlighting the need to explore the nuances of how financial instruments like money supply interact with other factors like access to credit to influence economic growth, particularly within specific contexts. They also emphasize the importance of considering the complex interplay between various financial instruments and economic actors to achieve sustainable economic progress.

The researches have proven the theory of Schumpeter that enhanced FD leads to economic expansion. They offer compelling evidence for the favorable connection between FD and EG. Furthermore, Kacho & Dahmardeh (2017) applied a dynamic panel data generalized technique to investigate the impact of institutional quality and FD on economic development and growth in Economic Cooperation Organization from the time period of 2002 to 2014. The research used six institutional indicators; stability in politics and absence of violence, the mean of opinion and response, effectiveness of administration, and quality of provisions, legality, and control on corruption as well as the ratio of gross product to private sector bank credit availability as financial indicators. Their findings suggest that in some countries, institutional quality as well as FD have an advantageous and positive influence on EG. The study concluded that strong institutional frameworks and FD could contribute to EG in developed countries. Moreover, Ahmed et al. (2022) investigated that policies of FD endorsed and designed by governments have a positive and significant effect on SED. On the bases of the above discussion; this research tests the following hypothesis:

H2: Financial development exerts a positive and significant effect on sustainable economic development.

2.3. Renewable Energy Consumption

Economic growth can be generated from modern industrial development, and energy is contemplated as a backbone of the production process to prosper economic growth. The unit elasticity theory has attracted significant attention after the 1973 oil crisis, often referred to as the OPEC oil embargo, had significant effects on the OECD countries during this period. The theory

tends to assess the alteration in economic gro   wth in relation to changes in energy consumption. After that time, the unit elasticity for energy use was documented as being less than one percent implying that for OECD countries, 1 percent EG required a less than 1 percent hike in energy consumption (Bhuiyan et al., 2021). Al-Mulali et al. (2014) examined the relationship between REC and EG by utilizing the data of 108 nations from 1980 to 2009. The study's findings showed that for 85 nations, REC and EG were correlated in both directions. According to the results, renewable energy is not correlated with growth in 21 nations. On the other hand, research witnessed a one-way relation between REC and EG growth in two nations. Overall, the REC and GDP growth had a long-run, positive, bidirectional link in 79 percent of the countries. Zeb et al. (2014) investigated the connections among the generation of energy from renewable sources, emissions of CO2, GDP, resource depletion, and poverty using data for Sri Lanka, Pakistan, India, Nepal, Bangladesh, and from 1975 to 2010. Findings indicate the two-way Granger causal correlation between emissions of CO2 and the depletion of Nepal's natural resources as well as between Pakistan's energy production and poverty. The findings also suggested Granger causation between energy output and poverty in Sri Lanka, Bangladesh, and, India as well as between poverty and energy production in those countries. In the battle for sustainable energy and environmental preservation, contemporary research has directed its attention towards examining the correlation between EG and the utilization of energy from renewable sources. For policymakers, deciphering the causal link between these two factors is paramount. Sustainability is seen to be impacted by renewable energy, either directly or indirectly (Inglesi-Lotz, 2016). Additionally, it is possible to view renewable energy as the key to removing barriers to sustainable development.

Güney (2020) find the relationship between energy from renewable and nonrenewable sources, EG, and SED in high-income nations. This study examines data from 20 developed nations from 1990 to 2015 and discovers a co-integration link between the variables under consideration. REC exerts a statistically beneficial impact on long-term development, in alignment with the assessment of sustainable coefficients for the co-integrated variables. The increase of 1 percent in REC promotes 0.326 percent sustainable development in high-income nations. Alternatively, Nonrenewable energy usage has a statistically significant adverse effect on long-term sustainable development. The increase of 1 percent in nonrenewable energy usage affects 1.004 percent sustainable development in high-income nations.

Paramati (2017) contributes to the findings, stating that increased economic activity in developing countries increases demand for energy, which is primarily derived from traditional sources. Moreover, traditional energy usage will have a significant negative influence on the environment. Consequently, attention of policymakers has recently shifted to boosting REC across all economic sectors in order to assure a low-carbon future. Considering the present circumstances, the objective of the research was to assess the influence of REC on economic outcomes and CO2 emissions in the world's rapidly advancing nations. The research has used the various econometric models of robust panel to analyze annual data from 1990 to 2012. The empirical data suggest a strong long-term link among the variables. Similarly, research suggests that using energy from renewable sources boosts economic output while lowering CO2 emissions. Based on the findings, study advocate that policymakers in those economies establish additional policy reforms to foster the generation and consumption of renewable energy across economic activities in order to ensure SED. The relationship between REC and SED in underdeveloped nations presents a multifaceted picture. While not always straightforward, research suggests a positive long-term trend. Studies by Ahmed (2019) and Paramati (2017) identified a favorable association between REC and EG. Paramati's work goes further, highlighting a reduction in CO2 emissions alongside economic benefits, showcasing the potential for environmental improvements. Fotourehchi (2017) strengthens this view, arguing that policies promoting renewable energy can positively impact EG. Bhuiyan's (2022) research adds another layer, demonstrating that REC significantly boosts economic growth in both developed (G7) and developing (N-11) nations, with a particularly strong impact exceeding a certain threshold level. These findings paint a promising picture, suggesting that embracing renewable energy can contribute to a sustainable economic future for developing countries.

Renewable Energy Consumption (REC) has captured significant attention over the past two decades due to its potential link with economic development (EG). However, research findings regarding this relationship present a complex picture. Several studies have identified a positive correlation between REC and EG. Sadorsky (2009) observed this trend in Sub-Saharan Africa and emerging markets, suggesting that increasing renewable energy consumption can act as a catalyst for economic growth in these regions. However, other studies paint a contrasting picture. Dogan (2015) found evidence of a negative relationship between REC and EG in

Turkey, highlighting the possibility of context-specific factors influencing this dynamic. Furthermore, research suggests a potential distinction based on a nation's development status. Some studies reveal a positive association between REC and EG in high-income countries, while low-income nations might experience a negative correlation. Alam and Murad (2019) work in OECD countries sheds light on this possibility. Their findings suggest that long-term economic growth can positively influence REC adoption, but short-term effects might be negative. This complexity underscores the need for further research that considers specific regional contexts, economic development stages, and policy frameworks to fully understand the multifaceted relationship between REC and EG. Unpacking these nuances is crucial for designing effective policies that leverage REC to achieve SED. By understanding the interplay between these factors, policymakers can create targeted strategies that promote renewable energy adoption while fostering EG, ultimately paving the way for a more sustainable future.

Another line of investigation examines the relationship between FD and REC. Given the high initial costs and long payback periods associated with the projects of renewable energy, getting financial backing for the creation of renewable infrastructure and the exploration of related technologies is critical. Babbar & Schuster (1998) were among the first to identify severe knowledge gaps in renewable energy project financing, highlighting the vital role of private investment in under developing countries. According to Brunnschweiler (2010), capital route efficiently from well-developed financial sectors into the renewable energy sector, whereas undeveloped financial sectors may obstruct credit flow into this sector. Wu and Broadstock (2015) discovered that institutional quality and financial growth have advantageous effect on REC in developing nations. The research also found that the growth in stock market and FDI might boost REC in South Africa as well as in Brazil, China, and India after investigating the effect of stock market development and FDI on REC in these nations. Sweerts et al. (2019) investigated the impact of financial standing on the generation of energy in 46 African nations, taking into account renewable technologies as well as fossil-based technologies. Their findings suggested that higher use of renewable energy was connected with lower financial expenditures.

Charfeddine and Kahia (2019) examined the correlation among REC, economic growth, FD, and CO2. Their findings revealed a limited explanatory link between REC, financial development, EG, and emissions of CO_2 in North and Middle Eastern African nations. Wind,

solar, and hydroelectric power have all gained popularity in efforts to minimize emissions of greenhouse gases and promote sustainable development. Their growing popularity stems from their ability to minimize greenhouse gas emissions and promote sustainable development. Studies have consistently shown a positive correlation between increasing REC use and economic growth (EG). This relationship aligns with the concept of the Environmental Kuznets Curve (EKC) put forth by Grossman and Krueger (1995). The EKC theory suggests an inverted U-shaped relationship between economic development and environmental pollution. In the initial stages of development, pollution levels tend to rise as countries prioritize industrialization. However, as economies mature and wealth increases, environmental concerns gain traction, leading to investments in cleaner technologies and stricter environmental regulations. The consequence is a decline in pollution levels. In the context of REC, the EKC theory implies that as countries experience economic growth, they are better positioned to invest in renewable energy infrastructure. This shift towards cleaner energy sources like solar and wind power helps to decouple economic growth from environmental degradation, a critical element of sustainable development. Additionally, the REC sector itself can act as a driver of economic growth. The development, installation, and maintenance of renewable energy infrastructure create new jobs and stimulate related industries like manufacturing and green technology research. This green economic stimulus further contributes to overall EG, creating a virtuous cycle that promotes both environmental and economic sustainability. Bhuiyan (2022) emphasizes the long-term potential of REC for achieving SED in underdeveloped countries; the specific circumstances for realizing this potential need further investigation. Overcoming infrastructure limitations, securing investments, and promoting technological advancements are all critical actions to empower these countries to leverage the power of RES and build a sustainable economic future.

Apergis and Payne (2012), Al-mulali et al. (2014), Pao and Fu (2013), and Sebri and Ben-Salha (2014) delved into the complex relationship between energy consumption, production, and economic development in China. Their research, spanning the period 1977 to 2013, focused on three key energy sources: coal, oil, and renewable energy. Interestingly, the studies revealed a two-way causal link between Renewable Energy Consumption (REC) and EG. On one hand, the research suggests that economic growth drives the demand for energy, including all three sources – coal, oil, and renewables. As economies expand, industries require more energy to fuel

production, households consume more energy, and transportation needs increase. This translates to a higher overall demand for energy resources. However, the studies also highlight a crucial flip side. Economic development can act as a catalyst for the adoption of renewable energy. As a nation's economy progresses, concerns about environmental sustainability often gain prominence. Additionally, economic growth can create the financial resources necessary to invest in renewable energy infrastructure and technologies. This can lead to a gradual shift towards cleaner energy sources like solar, wind, or geothermal, promoting a more sustainable energy mix. On the basis of preceding discussion, this research tests the following hypothesis:

H3: Renewable energy consumption has a positive significant impact on sustainable economic development.

2.4. Information and communication Technology

ICT has been considered as a vital component of global competitiveness due to the association with all areas of activity and impact on productivity, which in turn affects economic growth. Numerous studies examined the factors that influence and are affected by the development of ICT (Dahmani et al., 2021). Norton (1992) investigates the relationship between the rise of telephones correlates with the expansion of macroeconomic indicators across 47 industrialized and emerging economies from 1957 to 1977. According to the report, telecommunications infrastructure lowers the overall transaction costs for businesses, having a favorable and positive effect on EG. In the early 20th century, a negative correlation between EG and telecommunications infrastructure was observed in certain countries. ICT has a negative impact on industrial productivity in the context of the United States (Berndt et al., 1992). ICT and banking productivity in Canada has a negative correlation (Parsons et al., 1993). Morrison (1997) examined that there is little connection between ICT and business productivity.

There exists a strong link between investment in ICT and an ability of the country to innovate and succeed economically. As Bresnahan et al. (2002) shown in their study of US business output from 1987 to 1994, embracing ICT initiates a virtuous cycle that benefits both innovation and skilled workforce development, ultimately driving national economic growth. Their research indicated an important link: organizations that actively implement ICT advances prioritize staff training and devote significant resources to future ICT investment. This emphasis

on a tech-savvy workforce drives innovation, resulting in higher efficiency inside those organizations. The ripple effects then go beyond individual enterprises, helping to drive national economic growth. ICT investment is critical to developing a competent workforce, which is required for long-term economic growth. ICT enables individuals to gain the skills required to thrive in the digital age by giving educational opportunities through online platforms, permitting remote work, and encouraging collaboration across geographical borders. This expands the pool of talent, recruiting and keeping creative enterprises and eventually leading to a better national economy. However, it is critical to acknowledge that the correlation between ICT investment and economic growth is non-linear. Effective regulatory frameworks and infrastructural expenditures are critical for ensuring equal access to technology and education. Furthermore, individuals and enterprises must develop an innovative and continuous learning culture in order to fully realize the promise of ICT.

Numerous studies emphasize the critical importance of ICT in promoting SED. Matei (2012) highlights ICTs' significant contribution to the building of a sustainable knowledge economy, particularly inside the European Union. Raghupathi (2014) expands on this viewpoint by delving into the several ways in which ICTs actively contribute to global sustainability, including economic development, education, energy, environmental considerations, and transportation. Furthermore, Oloruntoyin (2013) emphasizes the role of ICTs in national development, emphasizing their ability to improve service delivery, transparency, and public access. These studies underline the transformative potential of ICTs across multiple sectors, confirming their importance in encouraging SED at the global, regional and, local levels. Furthermore, the innovative application of ICT fosters economic growth by fueling the creation of entirely new industries, jobs, and economic opportunities. The rise of e-commerce platforms, the gig economy facilitated by online platforms, and the burgeoning field of information technology itself are all testaments to this phenomenon. As Haftu (2019) points out, the ICT sector has become a significant revenue source for many governments, contributing directly to economic growth. ICT plays a crucial role in bridging the socio-economic divide, a key aspect of SED. Research by Lashitew et al. (2019) emphasizes the power of ICT to provide marginalized and low-income populations with access to essential educational resources and critical social services, including financial services like mobile banking and microloans. By empowering these underserved communities, ICT promotes social inclusion and fosters a more equitable

distribution of economic opportunities, contributing to a more sustainable economic development model. Another justification is that the Internet has a favorable impact on bilateral trade by lowering market fixed costs and demonstrating that the Internet stimulates trades. Furthermore, a 10 percent rise in utilization of internet might result in a 2 percent rise in export expansion. Moreover, the internet does not necessarily change the impact of distance on trade, but it make businesses more competitive through creating new service industries. This ultimately led to economic development of developing nations (Alshubiri et al., 2019).

Albiman (2018) explained the association among ICT, production, EG. The major goal is to emphasize the theoretical correlation between ICT and EG within a given economy. The impact of information development pervades all elements of daily life and is critical in government, corporate, and individual settings. During the 1980s and 1990s, one particularly notable economic development was the significant rise in the proportion of investment allocated into the Information and Communication Technology (ICT) industry. This expansion was especially noticeable in global economies, with industrialized countries enjoying a spectacular surge in ICT-related investments. Bahrini (2019) uses a panel growth model of Generalized Method of Moments (GMM) to investigate the effect of ICT on EG in selected developing nations in Sub-Saharan Africa (SSA) and Middle East and North Africa (MENA) regions between 2007 and 2016. The findings from the econometric model indicate that, apart from telephones landline, various other information and communication technologies including internet utilization, mobile phones, and the adoption of broadband played pivotal roles in driving economic growth in emerging nations across the MENA and SSA from 2007 to 2016. Additionally, the data indicates that countries in the Middle East and North Africa (MENA) region demonstrate greater levels of internet usage and adoption of broadband in comparison to nations in Sub-Saharan Africa (SSA). According to the findings, policymakers in both MENA and SSA countries should boost investments in ICT infrastructure. To capitalize on the ICT factors of EG, policymakers should implement various key policy reform that promote financial sector advancement, facilitate a regulatory and institutional environment conducive to convenience, enhance economic openness, allocate resources prioritizing ICT infrastructure development, and mitigate the negative impacts of government expenditure and inflation.

Niebel (2018) investigated the impact of ICT on the EG in a few developed, emerging, and developing nations. Data from 59 nations between 1995 and 2010 are used for this. The outcomes of the panel regression demonstrate that ICT has a favorable effect on capital growth and GDP. The projected results show that ICT's responsiveness is greater than its compensation. The findings of the regression line demonstrate that the EG of industrialized, emerging, and developing countries is significantly responsive to ICT. However, the assessment demonstrates that a lack of ICT in emerging nations prevents them from experiencing the expected economic growth. Habibi and Zabardast (2020) investigated the impact of ICT and education on economic growth in 24 OECD and 17 countries of Middle East. They used OLS, fixed-effect, and GMM approaches on a dataset that was collected during an 18-year period from 2000 to 2017. The results indicated that ICT had a positive effect on EG in both the Middle East and OECD countries. Moreover, fixed broadband, internet, and mobile users were found to significantly contribute to EG across low income, middle income, and high income nations. The study examined the collective effects of infrastructure of the ICT, financial development, and trade openness on economic growth for 85 countries spanning from 2000 to 2019, including 58 high-income and 27 low-income nations. It concluded that countries with low income, the combined effect of ICT infrastructure, FD, and TO positively influenced EG, whereas in high-income countries, the results were reversed (Singh & Kumari, 2023). This research tests the below mentioned hypothesis on the basis of above mentioned discussion:

H4: There is positive significant impact of information and communication technology (ICT) on sustainable economic development.

2.5. Socio-economic variables

Considerable literature has addressed the relationship among the natural resource abundance, international tourism, international trade, age dependency, FDI, FD and economic development. A natural resource, which includes rich land, expansive forests, mineral deposits, various materials, and life-giving water, has enormous potential for economic development. As Badeeb et al. (2017) underline, these natural resources are strategic tools ready to be used. Extensive research, such as that conducted by Venables (2016), has investigated a positive and significant correlation between resource availability and economic advancement. This link is strengthened further when considering the sheer volume of output created and the presence of

significant mineral reserves, as noted by (Stijns, 2005). These elements become critical drivers of a country's economic trajectory. However, using natural resources involves more than just extraction and exploitation. Sustainable techniques are paramount. Responsible management, which prioritizes both economic growth and environmental conservation, ensures long-term benefits for current and future generations. This entails expanding economies beyond resource reliance and encouraging innovation in areas such as renewable energy and eco-tourism. Furthermore, the equation isn't always clear. Mismanaged resource abundance can result in the "resource curse," in which affluence promotes corruption and stifles general progress. Transparent governance, equitable benefit distribution, and investments in education and infrastructure are critical to avoiding this mistake. Unlocking the actual potential of natural resources requires identifying synergies with other development areas. Combining resource wealth with technological improvements, skilled workers, and strong institutions yields an effective recipe for inclusive and long-term growth. Nations may pave the way for a bright future by wisely exploiting nature's endowments while maintaining vision and accountability.

The relationship between resource abundance and economic development is far from straightforward. Unlike a simple cause-and-effect scenario, it's a complex interplay influenced by factors like resource prices and regional policy differences. The key concept of Dutch Disease outlines the detrimental impacts of NRA on EG (Erdogan et al., 2020). Moreover, Zhang & Li's (2010) study in China exemplifies this complexity. Their research delves into regional disparities, demonstrating that resource availability has a more subdued effect on economic development in western and central China compared to the eastern region. This highlights the crucial need for nuanced policy approaches that acknowledge and address regional variations. Understanding these dynamics is paramount for policymakers. Simply possessing an abundance of resources isn't a guaranteed path to prosperity. Policymakers must delve deeper and grasp the multifaceted nature of natural resource consumption within their specific regions. This knowledge empowers them to craft effective policies that leverage these resources for sustainable and inclusive economic development. A one-size-fits-all approach won't suffice. Instead, policies should be tailored to address the unique circumstances of each region. For instance, regions with abundant natural resources may require policies that promote value-added processing of raw materials rather than mere extraction. This approach fosters job creation,

technological advancement, and higher returns on resource wealth. Additionally, policies that encourage diversification beyond resource dependence can help mitigate the risks associated with volatile commodity prices.

In contrast to the belief that natural resources abundance ensures long-term economic progress, the resource curse hypothesis contends that locations endowed with large resources are frequently trapped in poverty (Asif et al., 2020). This contradiction is especially visible in developing countries rich in fossil fuels and rare minerals, where geopolitical, sociopolitical, and military instabilities obstruct the realization of rapid EG (Badeeb et al., 2017). The precarious character of economic development in these places is compounded by volatile resource prices and rampant exploitation, which is frequently fueled by corruption. The resource curse hypothesis questions the popular understanding that abundant natural resources inevitably translate into economic development, putting insight on the complex issues that societies endowed with such resources face. This occurrence highlights the significance of strong governance, transparent legislation, and anti-corruption measures in ensuring that natural resource riches serves as a stimulus for long-term economic progress rather than a burden. To break free from the paradox of resource plenty impeding economic advancement in particular locations, it requires for a sophisticated grasp of the complexity of resource utilization (Abdulahi et al., 2019).

Nevertheless, there is a substantial positive correlation between international trade and SED, as it promotes exports of products and services, expands capacity and has a positive spillover impact on green technologies in in-transition economies (Essandoh et al., 2020). However, Kim's (2009) research contradicts the concept that trade openness has a uniform impact on development, exposing a nuanced reality in which high-income nations benefit and low-income countries may suffer. This viewpoint is supported by Dao's (2014) research, which highlights the possible negative repercussions of trade liberalization, particularly for indigenous businesses in low-income countries. Dobre (2008), in contrast, adds complexity to this story, arguing that the complex relationship between TO and growth, and that the success of various developing nations across the Asia and Latin America may be attributable to a variety of other variables. These various findings underlined the significance of a complex and context-specific understanding of the correlation between trade openness and development. The existing body of

literature further strengthens the argument for the positive impact of trade liberalization policies on SED in developing countries. Studies by Nepal et al. (2021) and Bashir et al. (2022) both highlight the favorable and substantial influence of trade liberalization on SED. By fostering international trade and promoting the integration of developing nations into the global market, trade liberalization can create new opportunities for tourism-related businesses and generate additional income sources. This ultimately contributes to achieving the goals of SED. The disparity between rich and low-income countries emphasizes the significance of taking into account the specific economic situations, institutional frameworks, and policy contexts that influence trade policy outcomes. Such insights are crucial for policymakers in developing strategies that capitalize on the benefits of trade openness while reducing any negative consequences, encouraging a more inclusive and sustainable approach to economic development. Whereas, FDI encourages environmentally friendly technology and increases capital mobility within developing economies. The transfer of green technologies coupled with FDI inflows and an efficiency enhancement decrease environmental deterioration and enhances sustainable development. FDI plays a crucial role in EG, but its consequences for long-term development are still being debated. Šimelytė (2013) and Kardos (2014) shed emphasis on FDI's positive potential in contributing to sustainable development, with Šimelytė (2013) underlining the need of FDI policies in ensuring sustainability. The environmental impact of FDI, on the other hand, is regarded as a problem, causing to call for additional research in this area. Gupta (2020) & Kacani (2020) broaden the discussion to a global level, with Gupta concentrating on the role of FDI in the global economy and Kacani on its impact on emerging economies. Both writers emphasize the potential of FDI to accelerate long-term economic development, but they also emphasize the importance of well-crafted policies that attract and efficiently manage FDI. The findings highlight the dual character of FDI, recognizing its beneficial benefits to EG and sustainable development while also emphasizing the importance of proactive measures to address possible environmental and social difficulties connected with foreign investments. This nuanced viewpoint is critical for policymakers seeking to maximize the advantages of FDI while balancing economic success and long-term sustainability. Moreover, Mert et al. (2020) propose in their "Pollution Halo Hypothesis," multinational corporations often utilize FDI as a means to introduce environmentally friendly technologies, like those that reduce carbon emissions, to developing economies. This technology transfer fosters the adoption of sustainable practices by

local businesses, mitigating climate change and promoting resource conservation. In essence, FDI serves a dual purpose: it acts as a source of financial capital and facilitates the spread of green technologies. This aligns with the findings of Hunjra et al. (2020), who advocate for policy reforms that incentivize FDI and recognize the tourism sector's contribution to SED. Furthermore, FDI in developing economies can directly stimulate the growth of the tourism industry by providing the necessary financial resources to develop natural infrastructure and eco-friendly tourism experiences.

Tourism's role in economic development presents a multifaceted picture. On one hand, academics like Çiftçioğlu & Sokhanvar (2021) highlight its significant contribution to economic growth and export expansion. Tourism acts as a powerful growth engine by generating foreign currency, creating jobs, and promoting a diverse range of industries within a destination country. Increased tourist spending stimulates sectors like hospitality, transportation, and retail, creating a ripple effect that benefits the overall economy. However, a more nuanced perspective emerges when considering diverse research. Studies by Skerritt (2005) and others point to tourism's positive impact on poverty reduction. Tourism development can create new job opportunities, particularly in service sectors, offering income-generating avenues for local communities. Additionally, tourism revenue can be channeled towards infrastructure development, improving roads, transportation networks, and communication systems. These improvements often benefit not just the tourism industry but also the local population, enhancing their overall living conditions. Despite these advantages, concerns regarding potential conflicts with sustainable development remain valid. Ali et al. (2021) and others raise crucial points about the dangers of uncontrolled tourism. A surge in tourist arrivals can strain natural resources like water and energy supplies. Unmanaged waste generation and irresponsible tourist behavior can contribute to environmental degradation. Furthermore, the economic benefits of tourism may not be evenly distributed, potentially exacerbating existing socioeconomic inequalities within the host community. The "tourism curse" looms big, as over reliance on this industry makes economies vulnerable to external shocks. Finding common ground requires a balanced approach. Recognizing the economic benefits while also addressing potential drawbacks is critical. It is critical to implement sustainable tourism strategies that stress environmental conservation, cultural preservation, and equitable benefit distribution. Engaging local communities, investing

in ethical infrastructure, and promoting eco-tourism programs are all critical steps toward reducing negative impacts. Finally, adopting a critical perspective on tourism's role in development reveals its actual potential. Fostering collaboration across stakeholders, from policymakers to local communities, enables the organization to capitalize on its economic advantages while ensuring long-term benefits for future generations. Only then will the sector be genuinely effective as a driver of positive and long-term development. Creaco's (2003) notion of sustainable tourism emerges as a strategic solution aimed at reconciling economic gains with environmental and socio-cultural preservation. Sustainable tourism entails a comprehensive framework that considers not just economic rewards but also environmental conservation and the preservation of local traditions. It promotes responsible travel, community engagement, and the adoption of eco-friendly projects to reduce the negative effects of tourism.

Population aging posed a threat to various economies around the world. Sustainable development of the country is impacted by an aging population through poverty and human welfare. There are grave concerns about population aging, which could lead to increased human dependence until 2050. It is prudent to consider human development initiatives to negate the negative implications of an aging population on the economy as the economy experience low productivity, higher cost of labor, stagnated economic progress, and decreased global competitiveness when it is unable to fill positions that are in high demand (Chapma & Shigetomi, 2018). The barriers that an aging population poses to long-term economic development, particularly in China, as underlined by Bai (2020), are diverse and must be carefully considered. A key problem is the inevitable fall in labor force participation, which can lead to lower productivity and creativity unless countered by technological advances or policies that encourage older workers to participate in the labor market. Furthermore, as Hong (2001) observed, greater national expenditure on the elderly might strain public resources and social welfare systems, necessitating creative financial and healthcare solutions. Furthermore, the decline in savings deposits due to an aging population has financial ramifications that could harm investment and economic stability. However, as Ono (2002) points out, it is critical to appreciate the complexities of the aging population's impact on EG and the environment. Under some situations, the accumulated wealth, spending patterns and capacity for knowledge transfer of an older populace may contribute to economic growth. Furthermore, if accompanied by movements

toward greener practices and consumption patterns, an aging population may result in a more sustainable environmental footprint. Following hypothesis is developed on basis of above mentioned discussion:

H5: There is positive significant impact of socio-economic variables on sustainable economic development.

2.6. Theoretical Framework

The structure outlined in Figure 1 serves as the foundation for this investigation. To explain the relationship between FI, FD, REC, ICT and SED, we used different theoretical lenses:

2.6.1. Innovation Ecosystem Theory:

Wang (2009) presents a complete approach for examining the discourse surrounding various innovations. It emphasizes the need of incorporating various populations and calls for a paradigm shift in both innovation research and policy formulation. The basic goal is to promote an approach that is motivated by real-world problems and encourages collaboration across disciplines. The framework aims to break down traditional silos in innovation studies by encouraging an interdisciplinary approach that recognizes the complex and linked nature of today's concerns. The ultimate goal is to promote a more holistic and problem-solving-oriented viewpoint in both academic research on innovation and policy formation, creating a more dynamic and effective approach to addressing multidimensional difficulties in the field of innovation. Innovation Ecosystem Theory focuses on the complex and interrelated linkages that exist among diverse actors and components within an ecosystem and generate innovation and economic progress. It highlights the collaborative and interconnected character of innovation processes, as well as how many entities such as corporations, startups, research institutions, governments, and investors interact and contribute to innovation. The theory highlights the significance of ecosystem actors collaborating, networking, and sharing knowledge. These contacts promote the exchange of information and ideas, which can result in innovation. The fundamental purpose of innovation ecosystems is to generate economic growth and development through the promotion of innovation, entrepreneurship, and the commercialization of new technology and ideas (Jacobides et al., 2018).

2.6.2. Theory of Environmental Governance:

According to the environmental governance theory, sustainability is attained by the protection of environment, which calls for a powerful regime such as government. As a result of a country's governance system consolidating environmental protection activities, which in turn improves environmental quality and ultimately results in sustainability, supporters of environmental governance theory have asserted that there exists a direct relationship between the effectiveness of government and the quality of the environment. One of the main principles of environmental governance theory is that environmental problems are complicated and interrelated. This means that traditional environmental governance measures, such as command-and-control regulation, tend to prove ineffective. Instead, environmental governance theory proposes that more collaborative and adaptive approaches are required. Another major conclusion of environmental governance theory is that environmental problems are not just environmental problems. They also pose economic, social, and political challenges. This implies that environmental governance must be connected with other areas of policy (Pattberg, 2015). Environmental governance theory includes a complete framework for controlling and regulating human activities in ways that enhance environmental sustainability. It recognizes the interdependence of ecological systems, human communities, and economies, and emphasizes collaborative and participatory approaches to addressing environmental concerns. Environmental governance, at its foundation, understands that effective environmental management necessitates the collaboration of a diverse range of stakeholders, such as governments, non-governmental organizations, businesses, local communities, and individuals. It aims to strike a balance between economic development and environmental preservation by utilizing a combination of rules, incentives, and voluntary activities to push behavior toward environmentally responsible behaviors. The theory emphasizes the significance of adaptable and flexible governing systems capable of responding to the dynamic and complex character of environmental concerns. Mechanisms for public participation, transparent decision-making processes, and the incorporation of scientific expertise are all part of this. Overall, environmental governance theory envisions a holistic and inclusive approach to stewardship in which diverse actors collaborate to ensure sustainable use of natural resources, mitigation of environmental degradation, and biodiversity protection for present and future generations (Begum, 2020).

2.6.3. Endogenous Growth Theory:

This theory introduced a new framework for understanding the drivers of EG. The theory suggested that internal factors such as human capital, creativity, and investment capital have a greater influence on long-term prosperity than uncontrollable external factors, undermining neoclassic theory of economics. Economists contend that heightened productivity correlates directly with accelerated advancement and innovation as well as increased investment in human capital. Consequently, they advocate for private sector entities and government departments to bolster innovative initiatives and provide incentives for individuals and organizations to foster creativity. This involves measures such as funding for research & development and protects the rights of intellectual property. The basic principles of the theory emphasized that there is a potential in government's policies to boost a country's growth rate by incentivizing businesses and entrepreneurs to conduct research and development and private sector investment in R&D to drive technological innovation. Endogenous growth theory first emerged as a critique and alternative to the prevailing neoclassical growth theory. The theory questioned how wealth disparities between industrialized and developing countries could exist if physical capital investment such as infrastructure yields diminishing returns (Pack, 1994).

The critical role of knowledge and innovation in fostering SED has been championed by prominent economists. Romer (1986) emphasizes knowledge as a unique good "non-rivalrous," meaning its use by one individual doesn't diminish its availability for others. This characteristic makes knowledge immensely valuable. Consequently, investments in education, research and development (R&D), and technological advancements can yield significant long-term economic growth. Imagine a scenario where advancements in renewable energy are readily shared and built upon by the global community. This collaborative knowledge creation fosters innovation and accelerates the transition towards a sustainable future. Building on this notion, Lucas (1988) made a groundbreaking contribution to the theory of endogenous growth. He places human capital accumulation, achieved through education and skill development, at the heart of economic development. His argument is clear: investments in education and skill training empower individuals to become more productive and innovative. This translates to a more skilled workforce capable of driving technological advancements, developing sustainable solutions, and ultimately propelling long-term economic growth. In the context of SED, a well-

educated population is better equipped to understand and address environmental challenges, fostering a more sustainable economic development model. By emphasizing the importance of knowledge and human capital, Romer (1986) and Lucas (1988) provide a compelling argument for prioritizing investments in education, R&D, and skill development. These investments not only contribute to economic growth but also empower individuals and societies to make informed decisions for a sustainable future.

2.6.4. Environmental Kuznets Curve (EKC):

EKC proposes a link between degradation of environment and progress of economies. According to the theory, increase in natural environment deterioration was witnessed in initial phases of economic growth and development, however further than a certain threshold of per capita income, the tendency reverses and environmental degradation begins to drop (Usenata, 2018). The EKC is frequently shown as an inverted U-shaped curve, with environmental deterioration increasing at a slower and slower rate as per capita income rises, until it eventually begins to fall. The EKC's tipping point is when economic progress begins to lead to environmental gains. The EKC, named after economist Simon Kuznets, contends that when a country enters the initial phases of economic growth, environmental deterioration tends to deteriorate. However, after a specific economic level, known as the turning point or threshold, environmental quality begins to improve. The graph depicts an inverted U-shaped trend, demonstrating that pollution rises with economic growth, peaks, and then drops. The first rise is ascribed to industrialization's intensive resource usage and pollution, but as civilizations become wealthier, they tend to invest more in environmental protection, adopt cleaner technology, and impose stringent regulations. According to Usenata (2018), the theory of EKC, there is a curve exhibiting an inverted U shape link between environmental deterioration and income per capita. Environmental consequences rise first but then fall as economies improve (Stern, 2017). However, the data is not strong, and the underlying mechanisms are still being contested (Stern, 2014). Despite advances in econometric methodologies, understanding of the EKC phenomena and empirical testing are still limited (Stern, 1998).

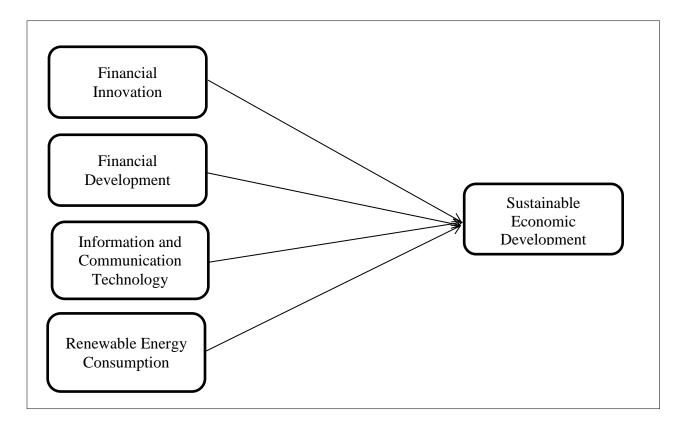**2.6.5. Schumpeter's Theory of Economic Development:**

Schumpeter initially presented his ideas on economic development in 1911 with the publication of his "Theory of Economic Development" in German. This seminal work was later translated into English in 1934. His theories continued to develop in two subsequent influential works: "Business Cycles" (1939) and "Capitalism, Socialism, and Democracy" (1950). The Schumpeterian framework of economic theory was developed to accomplish the necessary synergy between the social, economic, political, historical, and other aspects of the capitalism world's progress and functioning. It was believed that the only way to adequately access the economic aspects of reality was to investigate each of these various components of capitalist society independently (Croitoru, 2012). Schumpeter's economic development theory is characterized by four fundamental concepts: the circular flow, the pivotal function of the entrepreneurship, a recurring process and economic cycles, and the eventual demise of capitalism. Schumpeter's renowned theory regarding economic advancement highlights the significance of innovation and entrepreneurship in generating economic growth (Fritsch, 2017). This viewpoint is expanded in an evolutionary framework that emphasizes the dynamic interplay between organizations and their market environment (Sledzik, 2015). A crucial component of this theory is the symbiotic interaction between the static economic framework and the dynamic and progressive entrepreneur, with the entrepreneur serving as the active carrier of change processes (Velde, 2004). The idea also emphasizes the significance of virtuous leadership in controlling physical development as well as societal expectations of innovation (Velde, 2004). Schumpeter's method is considered as a challenger to neoclassical approaches in modern discussions, emphasizing the importance of innovation in driving economic advancement (Bazhal, 2016).

Schumpeter's theory of development emphasized on the dynamic process which is composed up of new resource combinations, like innovations, or technological advancements. The development process begins with the disruption in circular flow or stationary equilibrium followed by economic advancement and innovations in various areas including political, economic, social, and technology. Changes must be made to the economic system for it to become dynamic and consistent with development. The changes must be bringing through innovations. The entrepreneur holds a central position in Schumpeter's analysis of the

development process. The first step in Schumpeter's paradigm is the disruption of circular flow through innovation manifested through the introduction of novel products. According to the theory, entrepreneurship and starting new enterprises have significantly and favorably impacted economic growth and business cycles (Langroodi, 2021). Moreover, according to Schumpeter's theory rate of EG is determined by the increase of productive elements, technology, and an investment-friendly socio-cultural environment. Schumpeter's theory is still relevant today in explaining how capitalism evolves, adapts, and generates prosperity, putting entrepreneurship and innovation at the heart of dynamic economic growth processes. His ideas inspired following generations of economists and politicians, defining debates about the function of advancement in promoting EG and transformation (Velde, 2004).

Schumpeter's theory of economic development provides a valuable lens for understanding the link between FI and SED. He emphasized the critical role of innovation, entrepreneurship, and technological advancement in driving economic growth. FI acts as a powerful force in facilitating, supporting, and nurturing this SED process. By developing new financial products and services, FI empowers entrepreneurs to overcome hurdles related to financing, risk management, and business expansion. Venture capital firms, for instance, offer crucial funding for early-stage startups with high growth potential. Entrepreneurs can leverage credit markets to secure loans for new ventures, while derivatives markets equip them with tools to hedge against potential risks. Furthermore, FI can contribute to SED by fostering the development of more environmentally friendly and efficient businesses and technologies. Innovative financial instruments can incentivize investments in renewable energy, green infrastructure, and sustainable practices, paving the way for a more sustainable economic future. Moreover, the theory emphasized that economic growth is driven by innovation. ICT and REC are both quickly expanding industries, with new technologies and applications being developed all the time. This innovation is resulting in the establishment of new companies and jobs, additionally lowering the expenses associated with renewable energy sources and products and services of ICT. Entrepreneurs are considered as drivers of innovation. Both renewable energy and ICT are attracting a considerable number of entrepreneurs. These entrepreneurs are creating new products and services and assisting in the commercialization of renewable energy and ICT technology (Teece, 2018). Furthermore, financial development has been instrumental in the growth of the renewable energy industry. Green bonds, for example, are being used to fund

renewable energy projects all around the world. Financial products are becoming more accessible and affordable as a result of advances in ICT. Mobile banking apps, for example, are assisting in bringing financial services to consumers in developing countries (Hunjra et al., 2022).

2.7. Conceptual Framework

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│   ┌─────────────────┐                                                  │
│   │    Financial     │                                                 │
│   │   Innovation     │ ───────┐                                        │
│   └─────────────────┘         │                                        │
│                               │                                        │
│   ┌─────────────────┐         │                                        │
│   │    Financial     │        ▼          ┌─────────────────┐           │
│   │  Development     │ ──────────────────▶│   Sustainable    │         │
│   └─────────────────┘                     │    Economic      │         │
│                                           │  Development      │        │
│   ┌─────────────────┐                     └─────────────────┘          │
│   │ Information and  │                                                  │
│   │ Communication   │ ───────▲                                         │
│   │   Technology     │        │                                        │
│   └─────────────────┘         │                                        │
│                               │                                        │
│   ┌─────────────────┐         │                                        │
│   │ Renewable Energy │ ───────┘                                        │
│   │  Consumption     │                                                 │
│   └─────────────────┘                                                  │
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2.8. Definitions of the variables

2.8.1. Sustainable economic development: As per the World Commission on Environment and Growth, sustainable economic development is the pursuit of economic growth and advancement while concurrently considering and protecting a society's environmental, social, and cultural characteristics. It emphasizes the importance of meeting the current generation's economic requirements without jeopardizing ability of the future generations to meet their own. Essentially, SED attempts to strike a balance between economic prosperity, ecological integrity, and social equality in order to provide a comprehensive and sustainable enhancement of the quality of life for both present and future generations (James, 1989). The concept is further

defined by Barbier (1987), who states that real improvement can be achieved in third-world countries by developing and implementing strategies that are environmentally sustainable over time, in line with social values and institutions, and promoting 'grassroots' involvement within the sustainable development process.

During the annual conference of International Economic Development Council's 2016 in Cleveland, Ohio the working definition of SED is defined as: "Investments in various sectors, including business, social well-being, infrastructure development, and environmental protection, with the goal of promoting sustained prosperity for everyone, both presently and in the future" (IEDC, 2017).

2.8.2. Financial Innovation: FI can be specified as the development of novel financial products, services, or procedures that increase financial markets' efficiency, effectiveness, or accessibility. It can also be characterized as the creation of new methods for managing and mitigating financial risk (Gorton, & Merton, 1997). According to Sekhar (2013), FI entails the advancement of new financial products or the addition of new features to existing ones in order to reduce risk and achieve financial optimization. This is especially true in light of globalization and the necessity to manage foreign hazards. This innovation can take many forms, from the introduction of new types of financial instruments and investment techniques to breakthroughs in digital technology that transform financial service delivery. Financial innovation frequently occurs as a result of shifting economic situations, regulatory settings, and technological improvements. Its goal is to improve the efficiency, accessibility, and efficacy of financial systems by developing new solutions to satisfy the changing needs of consumers, businesses, and investors.

2.8.3. Financial Development: FD can be characterized as the enlargement of the scale, effectiveness, and resilience of financial markets, in addition to broadened access to these markets, leading to a myriad of benefits for the economy. It includes the evolution and extension of financial institutions, markets, and instruments, as well as the effectiveness of financial intermediation and financial service accessibility. User friendly financial solutions contribute significantly to EG and stability by easing the mobilization and allocation of funds, encouraging investment, and improving the efficiency of capital markets (Guru & Yadav, 2019). Furthermore, FD is a crucial factor in long-term economic growth, with measures such as financial market

supply having an important impact (Mehrara, 2014). This progress is being driven by the accumulation of knowledge via 'learning by doing,' which improves the allocation of savings (Lee, 1996).

2.8.4. Information and Communication Technology: ICT includes a broad array of technologies and techniques used for information capture, storage, processing, transmission, and dissemination. It consists of both hardware and software components and is critical in supporting the generation, management, and exchange of data and communication across multiple platforms. ICT encompasses computing, telecommunications, the internet, and other digital resources. It is the result of the integration of computer, microelectronic, and ICT, and it has revolutionized the functions and activities of information professionals in a variety of disciplines, including academic libraries (Arora, 2009). It is further defined as the computer and internet connection used to handle and communicate information for learning process (Shokeen et al., 2022). According to UNSCO, it is technical and scientific discipline and management technique used in the management of information, its engagement with cultural, economic, and social matters.

2.8.5. Renewable Energy Consumption: REC refers to the use of energy obtained from naturally replenishing and sustainable sources that are not depleted when used are referred to as renewable energy consumption. Renewable energy sources, as opposed to finite fossil fuels including oil, coal, and natural gas, are continuously supplied by natural processes, making them a more sustainable and environmentally beneficial option. Renewable energy can be harnessed from various sources like sunlight, wind, flowing water, underground heat, and organic materials. Consuming renewable energy entails transforming the energy from these sources into useable forms such as electricity or heat for a variety of applications. The goal to minimize dependency on fossil fuels, alleviate environmental effects such as emission of greenhouse gas and air pollution, and promote long-term energy sustainability is driving the transition to renewable energy (Bahr, 2020). Energy flows that are continuously renewed by natural processes are referred to as renewable energy. This contrasts with fossil, nuclear, and oil fuels, which are energy stocks rather than flows and are only available in finite quantities (Hersh, 2006).

2.8.6. International Tourism: International inbound tourists, referring to overnight visitors, are individuals who journey to a country distinct from their regular place of residence and beyond their habitual surroundings. This travel lasts for duration of up to 12 months and is pursued for reasons other than engaging in paid activities within the visited country (World Bank Metadata Glossary). International tourism is the movement of people from one country (the origin country) to another (the destination country) for pleasure, recreation, commerce, or other reasons. Individuals travel international borders with the primary goal of experiencing the destination country's culture, attractions, and activities. International tourists often spend a limited amount of time away from their customary environment and engage in activities that are out of the ordinary. However, Dehoorne (2014) defines international tourism as a complex and diverse phenomena with important geopolitical, economic, and social ramifications. It is distinguished from other service sectors by the export emphasis of its services. A variety of elements influence the industry, including international cooperation, market analysis, and the development of distinctive services (Culpan, 1987).

2.8.7. Trade Openness: TOP is the aggregate of products and services exports and imports, expressed as a percentage of gross domestic products (GDP) (World Bank Metadata Glossary). Trade openness is a complex term that is frequently quantified using the total trade to GDP ratio (Fujii, 2017). Trade openness refers to a country's level of international trade and commerce, which allows products and services to be exchanged across its borders. It measures a country's openness to global markets and engages in the trade of products and services with other nations. TO is normally measured by calculating the ratio of a country's total trade (the sum of exports and imports) to its Gross Domestic Product.

2.8.8. Foreign Direct Investment: FDI refers to net capital inflows directed toward obtaining a significant management interest, defined as ownership of ten percent or greater of voting shares in a company that operates in an economy different from that of the investor. This statistic includes equity capital, earnings reinvestment, various types of capitals including long-term and short-term as documented in the balance of payments. The provided series represents the total net FDI. BPM6 describes financial account balances as the difference between the change in assets and the shift in liabilities. The net outflows of FDI are considered assets, whereas net inflows of FDI are viewed as liabilities. FDI is a crucial component of economic globalization in

which a multinational corporation or organization acquires abroad assets (Plouffe, 2020). It is characterized by a foreign direct investor's long-term relationship and ownership of a resident entity in one economy. FDI can take the form of acquisitions and mergers or the establishment of a foreign branch, and it often entails the investor's active participation in the enterprise's management (De Santis, 2012).

2.8.9. Aging Dependency Ratio: The ratio of age dependency is a measure indicating the ratio of dependents, which includes individuals younger than 15 or older than 64, compared to the employable population, comprising those aged 15 to 64. This data is presented as the proportion of dependents for every 100 individuals within the labor force (World Bank Metadata Glossary).

2.8.10. Natural Resources Abundance: NRA pertains to the amount of natural resources possessed by a nation. Typically, measures such as per capita natural resources or average land resources are employed to gauge this abundance. On the other hand, the metric of per capita natural resources is influenced by the density of population in a given area and is intricately connected to economic and social conditions (Wu et al., 2018). Whereas, rent of natural resource encompass the cumulative value of rents derived from various sources, such as forest rents, oil, mineral, natural gas, and coal.

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1. Research Methodology

This research is designed as a quantitative and descriptive study, aiming to understand the impact of FI, FD, ICT and REC on SED.

3.2. Data collection

This research adopted panel dataset covering the years 1990 to 2022 of 44 selected developing countries. Developing countries have experienced notable changes in global financial markets and economic policies since 1990. Panel datasets covering the period from 1990 to 2022 provide robust and comprehensive data across multiple developing nations. This study concentrated on developing nations, where disparities in financial policy among nations were striking and concerns with sustainable economic development are pervasive. For data analysis, the panel data is gathered from the World Development Indicators (WDI) database, the United Nation Development Program (UNDP) database and Global Financial Development database. The time series data for Financial Development (FD), Information & Communication Technology (ICT), Renewable Energy Consumption (REC), International Tourism (INT), Trade Openness (TOR), Foreign Direct Investment (FDI), Aging Population Dependency (ADR), and Natural Resource Abundance (TNR) were all retrieved from WDI database, data for Financial Innovation (FI) was collected from Global Financial Development and data for Sustainable Economic Development (SED) was collected from UNDP database.

Table 1: List of Sampling Countries

Argentina	Costa Rica	India	Paraguay
Bangladesh	Ecuador	Indonesia	Peru
Barbados	Egypt	Iran	Philippines
Bolivia	Salvador	Jamaica	Senegal
Botswana	Fiji	Kenya	Sierra Leone
Brazil	Ghana	Malaysia	Panama
Cameroon	Guatemala	Mali	Sri Lanka
Chile	Guyana	Mexico	Thailand
China	Haiti	Mozambique	Turkey
Colombia	Honduras	Pakistan	Uganda

Uruguay	Venezuela	Zambia	Zimbabwe

3.3. Estimation Techniques

Penal data analysis

To test the proposed model, this research used the balanced panel data of 44 countries for the time period 1990-2022. The benefit of using panel data is that panel data provide more variability, less collinearity among the variables, more flexibility in modeling differences in behavior across the unit, higher degree of freedom and efficiency (Baltagi, 2005). To conduct the empirical analysis of this study Stata 14 statistical software is used. The balanced panel in this study is evaluated by using the pooled ordinary least squares (OLS), fixed effect, or random effect estimators. Pooled (OLS) includes both intercepts and slopes with a constant coefficient. Random Effect Model is identifies intercept term constant across all the units. The individual effects are randomly disperse across the cross sectional unit in order to capture individual effect. The fixed effect model is used to investigate the correlation between independent and dependent variable within a unit. Each unit is identified by its own individual characteristics. However, this study provides test in order to choose relevant estimation technique. This study runs Hausman Test to make choice between Random and Fixed Effect Model.

Given the results and constraints of these estimations, this study used Arellano and Bond's (1991) Generalized Method of Moments (GMM) to estimate a dynamic model of panel data. As GMM have advantages over other estimation techniques. As most of panel data set maintains serial correlation, GMM taking into account the heteroscedasticity and autocorrelation in error terms, resulting in consistent standard errors and parameter estimates. GMM is especially beneficial for addressing endogeneity issues in research, as it allows compensating for potential biases caused by correlated errors or omitted factors (Haq et al. 2016). GMM provides efficient estimations even with additional moment conditions and provides a formal framework for instrument variable estimate. GMM can help researchers find and employ valid instruments for consistent parameter estimates (Hansen, 1982). Unlike some other methods, GMM estimators can handle unobserved effects. They achieve this by either differencing the regression equation

(focusing on changes over time) or by using instrumental variables. Additionally, GMM is flexible and doesn't require strict assumptions beyond those justified by the underlying economic theory.

3.4. Model

Financial innovation is an important component since it represents a country's capacity to continuously upgrade its financial industry, fostering several key benefits. Firstly, FI drives efficiency by streamlining financial processes and creating new avenues for transactions. This can involve the development of online banking platforms, mobile payment solutions, or automated investment tools. Secondly, FI plays a crucial role in boosting access to finance, particularly for underserved segments of the population. Innovative financial products like microloans, peer-to- peer lending platforms, and alternative credit scoring methods can empower individuals and small businesses that may have previously been excluded from traditional financial services. Ultimately, this broader financial inclusion stimulates economic growth by unlocking the entrepreneurial potential within a wider population. The positive impact of FI on EG has been well-documented by scholars like Ajide (2016) and Gerged (2021). Both emphasize the critical role of a competitive and efficient banking industry, fostered by FI, in driving economic activity. Tarkhanova (2018) takes this argument a step further, highlighting the significance of financial and banking entities in ensuring SED. This connection lies in FI's ability to promote the use of environmentally friendly technologies. Innovative financial products like green bonds and sustainability-linked loans can incentivize businesses to adopt eco-friendly practices and invest in clean technologies. These studies collectively illuminate the interdependent relationship between FI, ICT, and FD in fostering SED. By fostering efficiency, expanding financial inclusion, and promoting environmentally conscious practices, FI acts as a powerful driver of a more sustainable and inclusive economic future.

Pradhan (2021) emphasizes the significance of co-curating these aspects for long-term development, especially in the context of Indian states. Păun (2019) underlines the importance of financial sector development and complexity in achieving long-term growth, a notion echoed by Verma (2023), who also emphasizes the favorable influence of ICT diffusion and FD on EG in low income nations. Pawowska (2022) expands on this topic by mentioning FinTech and its potential to drive sustainable development through innovative financial tools. In conclusion,

these studies collectively emphasize the importance of a multifaceted strategy for achieving sustainable economic development. FI, ICT, and FD all emerge as crucial drivers. FI fosters efficient resource allocation and empowers underserved communities. ICT enhances corporate efficiency and unlocks new economic opportunities. A robust financial system, meanwhile, stabilizes the economy and facilitates the channeling of resources towards sustainable endeavors. Furthermore, incorporating trade openness acknowledges the role of international exchange in fostering economic growth through increased exports and imports. Finally, including FDI highlights the significance of attracting foreign investment, which brings not only capital but also technology and essential skills, all vital ingredients for long-term economic success.

Recognizing the demographic issues that many developing countries face, aging population dependency is a key factor. Population aging has an effect on labor markets, productivity, and social welfare systems. Understanding this dynamic is critical for developing policies that strike a balance between EG and the requirements of an aging population. Both Radmehr et al. (2022) emphasize the beneficial impacts of TOP and FDI on EG, with Radmehr et al. (2022) emphasizing the relevance of skilled labor and international commerce. While international tourism is a key source of money and employment, it can have negative consequences on the environmental protection and socio-cultural well-being due to the depletion of resources and deterioration of environment (Neto, 2002). Development of sustainable tourism, with a focus on environmental, social, and economic elements, is critical to mitigating these repercussions Creaco (2003). The correlation between international tourism, energy consumption, carbon dioxide emissions, and economic growth has been investigated, and a call for ecotourism policies and energy resource management to weaken CO2 emissions has been issued. Dependence on natural resources can have a positive influence on SED. Hou (2018) discovered that utilizing natural resources has significant consequences for an economy's long-term development, implying that comprehensive actions to eliminate resource reliance are required.

This research consider following regression model to test the hypothesis:

$$SED_{it} = \alpha_0 + \alpha_1 FI_{it} + \alpha_2 FD_{it} + \alpha_3 ICT_{it} + \alpha_4 REC_{it} + \alpha_5 FDI_{it} + \alpha_6 APD_{it} + \alpha_7 INT_{it} +$$
$$\alpha_8 TOP_{it} + \alpha_9 NRA_{it} + \mu_i + v_{it} \qquad (1)$$

Equation 1 is final estimated model to investigate the effect of FI and economic stability in selected nations, Where u_i represents country fixed effects and V_{it} is the residual term. The dependent variable is human development index which measure SED. For financial innovation assessment, FI represents bank branches per 100,000 adults. For financial development assessment, FD is used to indicate domestic credit to the private sector. Whereas for the information and communication technology assessment, ICT represents fixed broadband, REC the renewable energy consumption measured by using the % of total final energy consumption, GDP (gross domestic product) is endorsed as an economic growth indicator, FDI represents the foreign direct investment, APD the age dependency ratio, IT the international tourism, TOR the trade-openness, NRA the total natural resource rent.

Table 2: Description of Variables

Variable Name	Symbol	Description of Variable	Source
Sustainable Economic Development	HDI	Human Development Index	Nogueira et al. (2022)
Financial Innovation	FI	Bank branches per 100,000 adults	Jungo et al. (2023)
Financial Development	FD	Domestic credit to private sector (% of GDP)	Nepal et al. (2021).
Information and Communication Technology	ICT	Fixed Broadband	Cheng Lu (2018)
Renewable Energy Consumption	REC	% of total final energy consumption	Samour et al. (2022)
International Tourism	INT	International tourism, receipts (% of total exports)	Nunkoo (2018)
Trade Openness	TOR	Trade (% of GDP)	Zahonogo (2016)
Foreign Direct Investment	FDI	Foreign direct investment, net inflows (BoP, current US$)	Din et al. (2021)
Aging Population Dependency	APD	The Age dependency ratio (% of working-age population)	Chapman & Shigetomi (2018)
Natural Resource	NRA	Total natural resources rents (%	Dogan et al. (2020)

Abundance		of GDP)	

CHAPTER 4

4. EMPIRICAL FINDINGS AND INTERPRETATION

As our data set is panel in nature and data of all the variables are in logarithm form. In the first stage empirical model is estimated with pooled OLS. Pooled OLS analysis considers both individual country effects (intercepts) and the overall trend (slope) across all countries.

Table 3: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
LSED	1408	-.2183765	.1044239	-.6307842	-.649968
LIT	967	.937432	.3941558	-.4444326	1.780034
LTOR	1407	1.760214	.2116984	1.138399	2.43929
LFDI	1375	8.908016	.9676335	5.020713	11.53665
LAPD	1452	1.813174	.1116739	1.56942	2.047184
LNRA	1398	.4562995	.563932	-1.188196	1.547333
LFD	1186	1.397439	.6070607	-2.792147	2.268024
LICT	822	.0318334	1.03972	-3.673028	1.658978
LREC	1368	1.49637	.4175713	-.3565473	1.988782
LFI	1306	.8841203	.4090079	-1.321489	2.154957

The Table 3 presents descriptive statistics for the study variables. The median values indicate the central tendency of the variables. The median value of SED is -.218 whereas, values of socioeconomic variables such as IT, TOR, FDI, ADR, and TNR are .937, 1.760, 8.908, 1.813, and 0.456. Moreover, values of independent variables FD, REC, and FI are 1.397, 1.496, and 0.884. The standard deviation (1.039) for ICT adoption is notably higher than the mean value (0.031). This suggests a wider spread in ICT adoption levels across the selected developing countries. There are two possible explanations for this observation. Firstly, the selected countries might be at different stages of ICT development, with some having adopted more advanced technologies than others. Another possibility is the presence of a data outlier, a country with a significantly higher or lower ICT adoption level compared to the others.

Table 4: Pooled OLS Estimation

Variables	Model 1	Model 2	Model 3	Model 4
LINT	.0025	.0003	-.0063	.0181***
	(0.52)	(0.07)	(-1.38)	(3.94)
LTOR	.0334***	.0286***	.0270***	.0239***
	(3.51)	(3.35)	(3.28)	(2.88)
LFDI	.0120***	.0090***	.0146***	.0086***
	(4.38)	(3.39)	(5.96)	(3.29)
LAPD	-.6699***	-.5856***	-.5173***	-.5795***
	(-26.65)	(-24.39)	(-21.46)	(-25.72)
LNRA	-.0019	-.0084**	-.0200***	.0029
	(-0.47)	(-2.38)	(-5.61)	(0.81)
LFD	.0169***			
	(5.05)			
LICT		.0162***		
		(7.63)		
LREC			-.0607***	
			(-11.76)	
LFI				.0607***
				(11.96)
Prob	0.00	0.00	0.00	0.00
No. of Obs	831	925	936	891

Note: The asterisks ***, **, * indicate significance levels at 1%, 5%, and 10%, respectively. The values of the t-statistics are enclosed in parentheses. The dependent variable under consideration is Sustainable Economic Development.

The Table 4 presents the results of Pooled OLS estimations, which directed the researcher to estimate with Random or Fixed Model. Moreover, Table 5 and 6 presents the results of Random and Fixed OLS model.

Table 5: Fixed Effect Model

Variables	Model 1	Model 2	Model 3	Model 4
LINT	-.0216***	-.0190***	-.0210***	-.0151***
	(-5.09)	(-5.72)	(-5.22)	(-3.85)
LTOR	.0362***	.0192**	.0377***	.0191**
	(3.55)	(2.41)	(3.92)	(2.13)
LFDI	.0283***	.0168***	.0262***	.0194***
	(16.10)	(11.90)	(16.09)	(12.29)
LAPD	-.3756***	-.1020***	-.3721***	-.3238***
	(-17.49)	(-4.81)	(-19.19)	(-17.80)
LNRA	-.0215***	-.0176***	-.0182***	-.0162***
	(-5.19)	(-5.43)	(-4.61)	(-4.46)
LFD	-.0042	S		
	(-1.47)			
LICT		.0196***		
		(19.35)		
LREC			-.0240**	
			(-2.54)	
LFI				.0380***
				(12.83)
P-Values	0.00	0.00	0.00	0.00
No. of Obs	831	925	936	891
Hausman Test	-15.36	56.86	10.36	-34.30
P-Values		0.00	0.1102	

Note: The asterisks ***, **, * indicate significance levels at 1%, 5%, and 10%, respectively. The values of the t-statistics are enclosed in parentheses. The dependent variable under consideration is Sustainable Economic Development.

Table 6: Random Effect Model

Variables	Model 1	Model 2	Model 3	Model 4
LINT	-.0205***	-.0181***	-.0201***	-.0131***
	(-4.89)	(-5.41)	(-5.10)	(-3.40)
LTOR	.0405***	.0242***	.0404***	.0236***
	(4.14)	(3.08)	(4.38)	(2.71)
LFDI	.0277***	.0167***	.0254***	.0189***
	(15.90)	(11.72)	(15.83)	(12.01)
LAPD	-.3875***	-.1318***	-.3743***	-.3352***
	(-18.33)	(-6.29)	(-19.67)	(-18.70)
LNRA	-.0223***	-.0192***	-.0191***	-.0173***
	(-5.59)	(-5.99)	(-5.02)	(-4.92)
LFD	-.0036			
	(-1.29)			
LICT		.0187***		
		(18.38)		
LREC			-.0325***	
			(-3.82)	
LFI				.0384***
				(12.96)
P-Values	0.00	0.00	0.00	0.00
No. of Obs	831	925	936	891
Hausman Test	-15.36	56.86	10.36	-34.30
P-Values		0.00	0.1102	

Note: The asterisks ***, **, * indicate significance levels at 1%, 5%, and 10%, respectively. The values of the t-statistics are enclosed in parentheses. The dependent variable under consideration is Sustainable Economic Development.

Table 7: Hausman Test

	Model 1	Model 2	Model 3	Model 4
Chai2 Values	-15.36	56.86	10.36	-34.30
P- Values		0.00	0.1102	

Afterwards, in Table 7, Hausman test is applied to make choices between the Random and Fixed OLS Models. In the Hausman test, null hypothesis states that "fixed effects are not

efficient estimates". In case of Model 2, null hypothesis is rejected and Model 3, null hypothesis is accepted. Moreover, autocorrelation test is applied. The null hypothesis, H_0: "there is no serial correlation" is rejected. Keeping in view the results, we safely concluded that our model is dynamic in nature; hence we used the Generalized Method of Moments (GMM) developed by Arellano and Bond (1991) to estimate our dynamic model of panel data. The dynamic GMM estimator provides consistent and significant findings. In Table 8 four different models are analyzed, which contain different variables as given in equation 1. In specification 1, the variable of interest is Financial Development and control variables are International Tourism, Trade Openness, Foreign Direct Investment, Aging Population Dependency, and Natural resource abundance.

Table 8: Empirical Findings

Variables	Model 1	Model 2	Model 3	Model 4
$LINT_{it}$	0.0040***	.0081***	.0119***	.0014
	(10.50)	(8.78)	(6.25)	(1.52)
$LTOR_{it}$	.0118***	.0071***	.0141**	.0094***
	(9.09)	(2.75)	(2.45)	(4.21)
$LFDI_{it}$	.0022***	.0012***	.0030***	.0043***
	(18.75)	(2.94)	(3.45)	(13.10)
$LAPD_{it}$	-.0447***	-.0295***	-.0476**	.0133
	(-6.08)	(-3.02)	(-2.10)	(0.24)
$LNRA_{it}$	-.0006	.0019**	.0026	-.0012
	(-1.61)	(2.11)	(1.35)	(-1.40)
LFD_{it}	.0021**			
	(2.11)			
$LICT_{it}$		.0007**		
		(2.11)		
$LREC_{it}$			.0131*	
			(1.86)	
LFI_{it}				.0017***
				(4.55)
LHDI (-1)	.9052***	.8766***	.8802***	.6882***
	(112.1)	(83.70)	(46.15)	(15.88)
No of Obs	769	588	634	532
Number of Instruments	430	397	41	411
Shapiro Wald Test chi2	434233.48	20970.15	10262.50	841437.43
Sargan Test	36.40668	530.1763	42.244	21.03619

P-Value	1.00	0.00	0.890	1.00

Note: The asterisks ***, **, * indicate significance levels at 1%, 5%, and 10%, respectively. The values of the t-statistics are enclosed in parentheses. The dependent variable under consideration is Sustainable Economic Development.

INT has a positive and significant (0.0040) impact on SED in developing countries. This influence manifests through multiple channels. Firstly, INT stimulates EG by generating income through various avenues. Tourist spending on accommodation, food, transportation, souvenirs, and local experiences injects a significant amount of money into the developing economy. Secondly, INT creates employment opportunities across diverse sectors. This not only empowers individuals but also fosters the development of necessary skills and strengthens local communities. Finally, INT often acts as a catalyst for infrastructure investment. As tourist destinations gain popularity, governments and private enterprises invest in improving transportation networks, communication systems, and utilities to cater to the influx of visitors. These infrastructure upgrades benefit not only the tourism sector but also the broader economy and resident population. These findings resonate with the research conducted by Hunjra et al. (2020). Their study suggests a positive correlation between tourist arrivals and environmental and natural resource productivity. This indicates that tourism can incentivize sustainable practices and encourage the efficient use of resources. Furthermore, it can promote process optimization and heighten sensitivity towards environmental concerns within the developing nation.

TOP has a significant and positive (0.0118) effect on SED in low-middle income nations. This impact unfolds through the powerful mechanism of trade openness. When a nation adopts TOP, it essentially removes barriers to international trade, allowing local businesses to access a much larger global market. This expanded market fuel SED in many ways. Firstly; trade openness encourages domestic companies to become more competitive. Facing competition from international firms, local businesses are incentivized to identify and implement cost-effective production methods. This focus on efficiency often translates into improved product quality, allowing domestic firms to compete more effectively on the global stage. Secondly, increased trade openness exposes domestic companies to new technologies, knowledge, and best practices. This exposure can lead to innovation and the adoption of more sustainable production processes. Findings of the research are aligned with existing study of Hye et al., (2016), which concluded

that a positive relationship exists between TOP, encompassing both specific trade measures and the overall trade openness index, and EG, observed in both the short term as well as long term.

FDI emerges as significant contributor that holds positive sign (0.0022) signifying positive impact on SED. Foreign direct investment has recently been regarded as vital to the success of emerging countries. This influence stems from FDI's ability to address critical needs within these economies. FDI acts as a crucial growth driver by injecting much-needed capital. Developing economies often lack the domestic resources necessary to fund large-scale infrastructure projects or industrial development. FDI inflows bridge this gap, allowing for investments in areas like renewable energy, transportation networks, and communication systems. These investments not only stimulate economic activity but also lay the groundwork for future growth. Additionally, FDI fosters domestic industry competitiveness through advancing technologies and innovative production methods. Foreign firms frequently invest in training programs for local workers and upgrading equipment with modern technology. These results cohere with recent studies by Hunjra et al. (2020) and Ayamba et al. (2020), both of which highlight the positive influence of Foreign Direct Investment (FDI) on SED. Both studies concluded that the FDI acts as a catalyst for sustainable development in several ways. Firstly, FDI provides much-needed financial resources for developing economies. These funds can be used to invest in infrastructure projects which directly contribute to environmental sustainability. Secondly, FDI can be channeled towards developing eco-friendly technologies and production processes, further promoting environmental protection.

Aging Population Dependency (APD) holds negative impact (-0.0447) on SED. The core challenge lies in the rising proportion of elderly individuals relative to the working-age population. This demographic shift can lead to a critical shortage of both labor and experienced workers. The subsequent decline in workforce size directly impacts productivity and economic output, hindering sustainable development. The negative impact of APD extends beyond economic concerns. An aging population places considerable strain on social security systems and healthcare infrastructure. With a larger proportion requiring healthcare services, the financial burden on the working population increases. This can lead to a reduction in disposable income, ultimately affecting domestic consumption and hindering EG. The result is completely in line with the report of United Nations stating that aging population is a global danger to various economies throughout the world (United Nations, 2017). Chapman and Shigetomi's (2018)

research reinforces this notion, demonstrating a negative and substantial effect of population structure on sustainable development. Their findings highlight the crucial link between EG, a key component of SED, and workforce size and productivity. A smaller workforce, driven by an aging population, can lead to stagnation in overall economic growth.

A negative (-.0006) impact of NRA on sustainable economic development at 1% significance level has been observed in selected developing economies. The probable justification is that when resource rich nations experience a surge in profits from exporting these resources, their domestic currency tends to appreciate significantly. This appreciation is a consequence of the substantial inflow of foreign currency into the domestic market. The negative consequence of this appreciation is that the country's exports become more expensive in the international market, while simultaneously making imported goods cheaper. This situation creates a de-industrialization effect, where domestic manufacturing sectors struggle to compete with the influx of cheaper imports. As a result, overall economic output can decline, hindering SED. Another possible justification is that when a significant portion of government revenue comes from resource extraction, it can lead to a neglect of other sectors. This reliance on resource rents creates a volatile income stream, as resource prices fluctuate in the global market. When prices fall, it can lead to economic instability and hardship. Sachs and Warner's (1995) research was one of the first to describe the negative relation between NRA and EG. This study concludes that natural resource-poor Singapore, Taiwan, Hong Kong, and Korea outperformed oil-rich countries like Mexico, Venezuela, and Nigeria. The probable justification is that countries with natural resources, mostly oil, generate foreign money by exporting oil. Transferring oil export revenues to the real sector stimulates economic growth by increasing output. The financial system facilitates this transfer. The financial system's primary function is to move savings to the real economy at a fair cost. In countries rich with natural resources, directing income from exports to unproductive areas instead of the financial system hinders economic growth.

Furthermore, empirical results of this research shows the significantly positive (0.0021) impact of FD on SED. This positive influence can be attributed to the fundamental role of capital in the production process. Capital acts as the unifying element, bringing together factors like entrepreneurship, natural resources, and labor to deliver desired goods and services to the

market. A scenario where entrepreneurs have innovative ideas and a skilled workforce is readily available, but access to capital is limited. This lack of financial resources renders these other factors dormant or underutilized. In contrast, a robust financial sector committed to sustainability facilitates the flow of capital towards eco-friendly businesses and projects. The positive impact of FD on SED extends beyond financing sustainable ventures. A well-developed financial sector fosters financial inclusion, allowing individuals and small businesses, particularly those operating in the green economy, to access the financial resources they need to thrive. This broader access to capital empowers communities, promotes social equity, and contributes to a more inclusive and resilient economic development model. Financial development plays a pivotal role in facilitating this process by promoting both saving and investment. A robust financial sector offers a wider range of financial instruments, encouraging individuals and businesses to save their surplus funds. These savings are then efficiently channeled towards investments through various mechanisms. This aligns perfectly with the findings of numerous studies, including those by Anwar et al. (2011), Paun et al. (2019), Hunjra et al. (2022), and Zahoor et al. (2022). These studies collectively highlight the positive impact of FD on EG, a key component of SED. By facilitating capital accumulation, lowering the cost of capital, and promoting risk management, financial development acts as a crucial engine for sustainable economic progress.

In model (2), financial development is replaced with ICT while keeping the entire control variable constant. There is a minor change in the coefficient of the control variables. In model (2) positive and significant impact of NRA is observed on the SED as contrary to model (1). NRA can be a powerful tool for developing countries to achieve SED. However, it requires careful management, investment in key areas, and a commitment to good governance and environmental sustainability. A 2005 study by the World Bank titled "The Extractive Industries and Sustainable Development" explores the conditions under which resource-rich countries can achieve sustainable development. It highlights the importance of good governance, investment in human capital, and diversification of the economy (Liebenthal et al. 2005).

Moreover, ICT has a positive sign (0.0007) with statically significant impact on SED. Through three avenues, ICT can operate as a driver for EG. Initially, ICT acts as a powerful tool for enhancing the productivity of country. Additionally, ICT facilitates improvements in product

quality through better production management, streamlined communication with suppliers, and enhanced quality control processes. These factors enable firms to pursue economies of scale and scope, ultimately leading to increased productivity and economic growth. Research by Pradhan et al. (2014) also supports this notion, highlighting the positive impact of ICT on both market access and product quality. Furthermore, according to Crandall and Singer (2018), internet consumption is an investment that fosters the job creation and employment growth. They specifically cite an examination of the broadband effects on job creation, welfare of the consumers, and production. This analysis reveals that estimates of broadband usage are conservative regarding economic and labor welfare.

In model (3), ICT is replaced with REC but kept all other control variables the same. The coefficients of these control variables changed slightly. Whereas, the results of NRA is same as above mentioned in model (1). Renewable Energy Consumption REC exhibits positive coefficient which is significant at 10% indicating weak but positive effect on sustainable economic development. The correlation between REC and SED in underdeveloped countries is more nuanced than a simple positive or negative association. Several factors contribute to the observed weakness in this relationship. Firstly, underdeveloped countries often struggle with insufficient infrastructure and limited investment. This lack of foundational support hinders the widespread adoption of renewable energy technologies. Building and maintaining solar panels, wind turbines, or geothermal plants requires significant upfront costs, and underdeveloped nations may struggle to secure the necessary funding. Secondly, the initial cost of renewable energy technologies can be high compared to traditional fossil fuels. Thirdly, limited technological capabilities can further impede the adoption of REC. Developing countries may lack the skilled workforce and research infrastructure necessary to maintain and develop renewable energy technologies effectively. These challenges resonate with Chen's (2020) research, which employs a threshold model. There model suggests that the positive influence of REC on EG, a key component of SED is contingent upon achieving a certain level of consumption. Studies by Ahmed (2019), Paramati (2017), Fotourehchi (2017), and Bhuiyan (2022) highlight the long-term potential of REC for SED.

In model (4), INT has insignificant impact on SED. The possible justification is that uncontrolled tourism can harm the economy through leakage of tourist spending to foreign

businesses and inflated local costs due to high demand can undermine the economic benefits for the host country. It can adversely effect the pollution, deforestation, resource strain, loss of cultural identity, rising living costs for locals, and potential labor exploitation. In contrast to previous models, ADR has a positive but insignificant impact on SED. The possible justification is that an aging population can bring a more experienced workforce and potentially higher savings rates. Additionally, a rigid labor market that resists employing older adults could further limit the positive impact of their experience. Remaining controlled variables has the same impact as defined in previous models. Moreover, model (4) strengthens the case for FI as a driver of SED, reflected in the positive coefficient (0.0017). FI encompasses more than just flashy new financial products or institutions. It also includes seemingly mundane yet impactful advancements. Consider breakthroughs in credit scoring and data processing technologies. These have significantly enhanced the ability of financial institutions to assess borrowers effectively. This, in turn, allows for better allocation of financial resources, particularly towards previously underserved segments of the population. Additionally, the deployment and upgrades of private credit departments within financial institutions contribute to a more efficient and inclusive financial system. Findings of the research are aligned with (Michalopoulos et al. 2011). This positive influence of FI on economic development has historical roots. As early as 1912, economic growth theory, as outlined by Mishra (2008), emphasized the crucial role of financial institutions in fostering economic progress and innovation. By facilitating the flow of capital, mitigating risk, and promoting financial inclusion, FI empowers individuals and businesses to invest, grow, and contribute to a more vibrant and sustainable economy. A recent online debate hosted by The Economist underscored the critical role of Financial Innovation (FI) in driving long-term economic growth (EG), a key component of SED. The discussion concluded that FI has been a significant force in propelling economic progress over the past two decades (Beddoes, 2020).

Table: 9 Cross Country Analysis- Middle Income Countries

Variables	Model 1	Model 2	Model 3	Model 4
INTit	0.0097***	0.0097***	0.0085***	0.0077***
	(4.40)	(4.48)	(4.03)	(3.80)
TORit	0.0042**	0.0021**	0.0019**	0.0023
	(3.15)	(2.18)	(3.15)	(0.217)
FDIit	0.0018*	0.0016*	0.0016*	0.0011**
	(2.06)	(1.92)	(1.82)	(2.78)
ADRit	0.0050	-0.0094**	-0.0074***	-
	(0.19)	(-2.95)	(-4.29)	0.0020***
				(-4.28)
TNRit	0.0077***	0.0084***	0.0075**	0.0061***
	(3.48)	(3.86)	(3.15)	(2.87)
FDit	0.0101**			
	(2.17)			
ICTit		0.0004***		
		(3.54)		
RECit			0.0029***	
			(3.47)	
FIit				0.0093***
				(3.49)
HDI (-1)	0.994**	1.0776***	1.1005***	1.0126***
	(3.17)	(15.15)	(13.94)	(14.06)
No of Obs	207	211	224	224
Number of Instruments	33	32	33	33
Shapiro Wald Test chi2	326.82	410.21	350.72	402.65
	(0.0000)	(0.0000)	0.0000	0.0000
Sargan Test	46.2135	41.323	24.1589	36.642
P-Value	0.4200	0.1576	0.8256	0.0475

Note: The asterisks ***, **, * indicate significance levels at 1%, 5%, and 10%, respectively. The values of the t-statistics are enclosed in parentheses. The dependent variable under consideration is Sustainable Economic Development.

Table: 9 Cross Country Analysis- Lower Income Countries

Variables	Model 1	Model 2	Model 3	Model 4
INTit	0.0037**	0.0075**	0.0031	0.0041***
	(4.07)	(4.31)	(0.90)	(3.17)
TORit	.0195**	.00854	0.0170*	0.0177*
	(2.05)	(1.78)	(1.84)	(1.88)
FDIit	0.0012	0.0017*	0.0013	0.0015
	(0.87)	(1.95)	(0.97)	(1.10)
ADRit	-0.0417**	-0.0329	-0.0326	-0.0384
	(-3.15)	(-1.40)	(-0.92)	(-1.10)
TNRit	-0.0066**	-0.0069	0.0058	(-0.0064)
	(-2.67)	-0.34	(-1.52)	(-1.63)
FDit	-0.0014			
	(-0.56)			
ICTit		0.0077		
		(0.91)		
RECit			0.028*	
			(1.93)	
FIit				0.0003
				(0.93)
HDI (-1)	0.9207***	0.9100***	0.9202***	0.9052***
	(22.86)	(32.06)	(26.54)	26.22
No of Obs	414	284	445	435
Number of Instruments	35	29	35	32
Shapiro Wald Test chi2	856.84	1582.02	1073.54	1070.42
	(0.0000)	(0.0000)	0.0000	(0.0000)
Sargan Test	30.1818	25.566	27.519	
P-Value	0.3060	0.2235	0.4366	

Note: The asterisks ***, **, * indicate significance levels at 1%, 5%, and 10%, respectively. The values of the t-statistics are enclosed in parentheses. The dependent variable under consideration is Sustainable Economic Development.

In cross country analysis this study has divided the selected countries into two groups, G1 and G2 based on the economic status. G1 group of countries consists of Lower Income Countries and G2 group of countries consists of Middle Income Countries. The classification is based on World Bank's income classification system. Most countries in G1 have a GNI per capita below $4465, indicating Low-Income status. However, countries in G2 have a GNI per capita above $4465, indicating Middle-Income status (World Bank, 2023).

The results indicate that in the G1 group of countries, FI, REC, FD, and ICT positively and significantly impact sustainable economic development. In contrast, in the G2 group of countries, FD has a negative impact on SED, while ICT and FI have an insignificant impact. However, REC has a positive and significant impact on sustainable economic development. Middle-income countries outperform low-income countries in financial innovation, renewable energy consumption, financial development, ICT, and sustainable economic development. The stronger infrastructure supports more efficient economic activities and development projects, and skilled and innovative workforce drives advancements in financial technologies and renewable energy adoption. Additionally, economic stability and robust financial systems in middle-income countries make the countries more attractive to foreign direct investment, which supports financial development and ICT growth and promotes sustainable economic practices. In contrast, lower-income countries are less equipped to achieve sustainable economic development. The G1 group faces capital allocation problems due to low savings rates. Moreover, these countries encounter significant barriers, such as limited infrastructure, weaker financial institutions, and restricted access to capital, which hinder their economic growth opportunities and capacity for innovation and sustainable development (Hussain et al., 2023).

5. CONCLUSION

This study explores the impact of FI on the SED on developing countries considering the control variables including FD, REC, ICT, TOP, INT, FDI, NRA, and APD. This study examined the panel of 44 developing economies from the time period of 1990 to 2022 and used GMM estimator to control the problem of auto correlation. The research emphasizes the influence of financial innovation, finance development growth frame work, renewable energy consumption, ICT, natural resource availability, foreign tourism, aging populations, and international trade on Sustainable Economic Development

To achieve the first objective, the results found that financial innovation positively contributes to the sustainable economic development in the selected developing countries. Innovation in financial system improves access to financial services and enables better allocation of resources to underserved populations. To achieve the second objective, the empirical results explores that FD exerts the significant positive impact on SED because capital acts as the

important driver for economic production, combining ideas, labor, and resources to create goods and services. Limited access to capital can stall an economy. To achieve third objective, results explores the role of ICT to achieve SED. It shows that ICT boosts national productivity by improving production management, communication, and quality control. This also provides broadband access in developing regions that drives overall economic growth. In developing countries ICT has positive and significant impact on SED. To achieve forth objective of the study, the empirical equation explores that REC has weak significant impact on SED. Renewable energy offers potential for sustainable development, but underdeveloped countries face challenges. Weak infrastructure, limited investment, and high upfront costs for new technologies hinder widespread adoption of REC.

Other variables including TOP, INT and FDI have positive and significant impact. TOP fosters competition, innovation, and access to new markets, leading to economic growth. INT injects revenue, creates jobs, and can stimulate infrastructure development. FDI brings capital, technology, and expertise, boosting productivity and fostering new industries. These factors combined contribute to a stronger, more diversified economy, which is a key driver of SED. Whereas, APD has statically significant and negative effect because fewer workers and higher costs for retirees strain government budgets, limiting investment and slowing economic growth, hindering SED. Lastly, NRA holds insignificant and negative impact as the reliance on easily extractable resources can discourage diversification of the economy, leading to vulnerability when resource prices fluctuate. The study clearly point out the significant impact of financial innovation; thus financial institutes of that developing countries should focus on promoting financial technologies that support sustainable economic growth. It underscores the need for coordinated efforts among financial, energy, ICT, tourism, trade, natural resource, and aging population policies to drive sustainable economic development. Emphasizing the intricate interplay between economic growths, environmental sustainability, social inclusion, and technological innovation, policymakers are urged to adopt a holistic approach that balances these factors effectively.

6. POLICY IMPLICATIONS

Financial innovation holds significant importance for SED in developing countries. It promotes inclusive growth by increasing access to financial services, particularly for underprivileged groups. The study suggests various policy implications:

1. To ensure sustainable economic development in developing countries, ministry of finance should devise regulatory frameworks and hybrid models to support financial innovation through new financial products, digital banking, fintech solutions, and services. Furthermore, strong data security and privacy policies need to be formulated to address the issues associated with rising reliance on data-driven technologies.

2. Central Banks and policymakers in selected countries should prioritize strategies that enhance financial development, increase the availability of financial resources, and ensure efficient mechanisms for directing capital towards impactful industries that contribute to sustainable development in developing nations.

3. Ministry of telecommunication and IT in selected countries should build a comprehensive ICT infrastructure in order to ensure widespread broadband access, and reducing financial barriers through incentives. Moreover, government should support investments in technology industry to foster innovation and entrepreneurship in low-middle income countries.

4. The findings imply that government/ministry of energy and power division in developing countries should focus on strengthening institutional capacity and establishing well-defined regulatory frameworks within the energy sector. This would provide a solid foundation for implementing effective energy policies that incentivize the use of renewable energy sources for electricity generation.

A comprehensive policy approach is required to handle the multifaceted impact of financial innovation, financial development, information and communication technologies (ICT), renewable energy consumption, trade openness, international tourism, FDI, aging population dependency, and natural resource availability on long-term economic development. This requires a delicate balancing act in which policies should be customized to each country's specific situation, taking into account its unique difficulties and potential. To maintain a resilient and

inclusive development trajectory, policymakers must embrace a long-term vision that prioritizes environmental and social sustainability alongside economic growth.

7. STUDY LIMITATIONS

New researchers could have been more than one group of countries or clusters based on similar economic conditions and resources to have a more justifiable analysis. Furthermore, researchers can analyze the variables within the contexts of specific industries, different countries, and through comparative studies. It is essential to explore the impact of financial innovation by adopting micro-level data. This approach allows for a detailed examination of individual and small-scale transactions, providing insights into the nuanced effects of financial innovations on various economic agents and sectors. To further enhance understanding of the complex relationships between these variables, additional research is needed. Future studies can investigate the influence of regulatory frameworks, government policies, education and capacity-building initiatives on financial innovation.

Bridging these research gaps is essential for crafting comprehensive policy frameworks that address the multifaceted interactions between different variables, ultimately leading to a more nuanced understanding of long-term economic development.

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G1 Lower Income Countries		G2 Middle Income Countries	
1.	Bolivia	1.	Argentina
2.	El Salvador	2.	Barbados
3.	Jamaica	3.	Chile
4.	Guatemala	4.	Costa Rica
5.	Guyana	5.	Ecuador
6.	Honduras	6.	Panama
7.	India	7.	Peru
8.	Indonesia	8.	Brazil
9.	Philippines	9.	Colombia
10.	Sri Lanka	10.	Mexico
11.	Pakistan	11.	Uruguay
12.	Bangladesh	12.	Venezuela
13.	Haiti	13.	China
14.	Egypt	14.	Malaysia
15.	Ghana	15.	Thailand
16.	Kenya	16.	Turkey
17.	Senegal	17.	Iran
18.	Zambia	18.	Botswana
19.	Zimbabwe	19.	Paraguay
20.	Mozambique		
21.	Sierra Leone		
22.	Uganda		
23.	Cameroon		
24.	Fiji		
25.	Mali		