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Digital Financial Inclusion, CO_2 Emission and High Quality Development: A Panel Data Approach from South Asian Economies

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Abstract: *This study examines that relationship between the High Quality Development index (HQDI) and Digital Financial Inclusion (DFI) in nine South Asian Economies between 2013 and 2023. By using CO2 emissions as a mediating variable, it examines the direct and indirect effects of DFI on development quality. The Endogenous Growth Theory, which highlights the financial integration and technological advancement as important forces behind sustainable development, serves as the theoretical underpinning for the study. To evaluate the impact and mediating pathways, the study used the Sobel mediation analysis and fixed effects panel regression. The findings shows that DFI increases CO2 emissions and positively and significantly contributes to HQDI, suggesting a trade-off between development and environment. The relationship between DFI and HQDI founds to be mediate by CO2 emissions, indicating that although digital finance promotes growth, it also presents environmental challenges. To make the model stronger, the control variables like GDP, population growth, and the use of renewable energy also added. These findings have significant implications for policymakers who aim for a balance environmental sustainability and digital transformation. Encouraging green digital finance policies could improve the region's high-quality development while reducing carbon risks.*

Keywords: Digital Financial Inclusion, High Quality Development Index, CO2 Emissions, Panel Data Regression, South Asia

Introduction

The evolution of the financial inclusion may be attributed to the global efforts devoted to the enhancement of the financial services availability to fight against the poverty and inequality. This is because the traditional financial inclusion focused on the physical infrastructure of banks in the first place (Quoc et al., 2024). Nevertheless, the rapid progression of the Technology for information and communication drove the place of the concept of a digital financial inclusion (DFI) into being more commonly known. It employs such technologies as cloud computing, big data analytics, fintech applications, and mobile banking to provide financial services to underserved populations or historically underserved people (Xi & Wang, 2023). According to the World Bank Global Findex Database (2021), digitization of financial services has transformed the relationship of individuals with the finance system comprehensively, especially within the developing nations, referring to the Web-based financial services like digital wallet, online payments, and cash on phone. ATMs per 100,000 adults, bank branches per 100,000 adults, commercial banking institutions, outstanding loans, and deposits as a percentage of GDP the five main indicators used to create the DFI index.

More recently, Xi & Wang (2023) state that there has emerged the concept of HQDI as a comprehensive framework that takes into consideration the environmental, social as well as the economic sectors of development. The Chinese development model has influenced this notion specifically by preparing the ecological protection, transparency, and shared prosperity in the development goals (Lin & Wang, 2021).

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Scholar argues that in an emerging economy especially, digital financial inclusion could be used as a high-quality development catalyst when they are aligned with efforts to minimize carbon emissions. Such kind of the triangular correlation between DFI and the CO_2 emissions as well as the HQDI is thus increasingly being analyzed in current empirical research particularly with the change of South Asia towards the green digital economy (Liu et al., 2023; REN21, 2021). The five equally weighted dimensions of innovation, coordination, green development, openness, and sharing used to calculate HQDI.

One of the principal concerns observed is the increase of CO_2 emissions caused by the rapid industrialization and development of digital infrastructure, including data centers and energy-intensive tech-related services like fintech (Sadiq et al., 2024). Digital finance boosts the efficiency of the economy but unless it is integrated with low-carbon policies and green investment strategies, it actually would promote more carbon emissions. Due to such a dichotomy, carbon emissions (CO_2) are becoming a topic of interest now as an intervener between the outcomes of sustainable development and DFI (Zhang et al., 2022).

DFI has gained increased relevance as an agent of change related to inclusive growth, particularly in the impoverished South Asian regions. It takes advantage of technology to deliver financial services to the underserved, which enhances equity, innovation and efficiency. Nevertheless, the responses during the pandemic are putting pressure on sustainable development, including the environmental impact of digital infrastructure in expanding CO_2 emissions. This paper analyses the impacts of DFI on the High Quality Development Index (HQDI) both directly and indirectly through carbon emissions in nine of the South Asian economies over the period 2013 to 2023. The methodology is based on the Endogenous Growth Theory where attention is given to the domestic factors in sustained growth such as innovation and technology.

It indicates that CO_2 emissions as a mediating variable has considerable effect upon the relationship between DFII and HQDI that was confirmed by the Sobel test. This agrees with (Sadiq et al. 2024), which argue that despite the accelerating effect of digitalization on development, it can lead to even greater carbon emissions because more energy is needed to enhance the work of the data infrastructure and mobile financial services. Consequently, the results imply twofold effects: DFII possibly guarantees high-quality development as an immediate result, but indirectly, it might affect it in the environmental outcomes, either positively or negatively, depending upon how green finance and energy transitions will be managed. Controlling variables in the study include Population Growth, GDP Growth, and Renewable Energy Consumption aimed at maintaining robust results of the study. The above factors are critical because they contribute to the level of financial access as well as the development outcome.

The main objective of the study is how Digital Financial Inclusion (DFI) influences the High-Quality Development Index (HQDI) in nine South Asian countries over time between 2013-2023 with CO_2 emissions serving to mediate the outcome. Another question in the study is to learn the effects of DFI on areas of sustainable development taking into consideration such important control variables as GDP growth, population growth, and consumption of renewable energy. The main research question that underpins this research is How do the factors of Digital Financial Inclusion affect the development of High-Quality in South Asia, and what can be its mediating mechanism regarding the contribution made by CO_2 emissions?

Although most research has examined the implications that digital financial inclusion has on other factors, such as consumption patterns, the innovation of enterprises, and financial efficiency (Dinh Le Quoc et al., 2024; Xi & Wang, 2023), the empirical examination of how DFI enables high-quality development, especially in South Asia using environmental mediators, e.g., CO_2 has yielded few results. Most existing studies in China or other areas of development are based on a small number of proxies of development, but often they do not use more inclusive multi-dimensional indices, such as the HQDI, which incorporates innovation, coordination, green growth, openness and social equity (Zhang et al., 2022; Lin & Wang, 2021). Also, the impact of DFI on emissions that may be two-fold since the impacts of digital infrastructure ultimately increased emissions even though the digital infrastructure encourages growth has not yet been totally modeled particularly when CO_2 will act as a mediating variable. Moreover, the context-specific controls such as GDP, population growth and renewable energy use have not been used

widely in South Asian examinations (Nauman et al., 2024). The current research contributes well to the existing development and sustainability literature, in which there are very distinct published studies that capture both direct and indirect effects of DFI on HQDI in the South Asian region.

The research paper explored the role of the DFI in the improvement high-quality development in countries of South Asia. The analysis of the panel data during the 2013-2023 and accounting of such control variables as GDP growth, population growth, and consumptions of renewable energy led to the research identifying the positive dependence upon the High-Quality Development Index (HQDI) and the DFI. It was noted that higher digital availability of financial services Promotes innovation, environmental sustainability, social inclusion, and economic coordination that forms foundation of HQDI. In addition, the paper sheds light on the intervening factor of CO_2 emissions implying that, on the one hand, DFI drives development, and, on the other hand, environmental consequences need to be addressed with conscientious digital expansion. The results provide evidence that there is still a high demand on strong digital financial systems, green policy and investment in green technologies to guarantee that the positive DFI outcomes are converted into long term, inclusive and environment-friendly development in the region.

Literature Review

This chapter contains the theoretical underpinnings of ongoing research as well as a review of earlier work about the effects of DFI on the High Quality Development Index. The world felt financial landscape changed considerably during the last 20 years, especially in consideration of the increased use of digital technologies. During the early 2000s, the focus of financial inclusion strategies was to get into the traditional banking infrastructure into new locations to serve the underserved areas (Claessens, 2006). However, these could only be limited by the lack of physical infrastructure particularly in the developing world. At this time, internet banking and mobile phones were not largely being used, and the low-income groups still faced a greater problem of joining the financial world (Honohan, 2007).

In the 2010s, along with the availability of mobile networks and digital platforms, Digital Financial Inclusion (DFI) became one of the most suitable tools in closing the gap between the financial system and the unbanked population. The mobile money system as successful in Kenya such as the M-Pesa (Jack & Suri, 2011) revealed the prospects of digital platforms in transferring affordable and convenient financial services. This trend was an early indicator of a larger trend towards digital finance as a driver of progress throughout Asia and Africa with multilateral organizations like the World Bank and IMF taking up digital inclusion by encouraging its use in the national development plans (Demirgüç-Kunt et al., 2015). Programmes like the Pradhan Mantri Jan Dhan Yojana in India and the National Financial Inclusion Strategy in Pakistan were of utmost importance in advancing the digitization of the financial systems in the South Asian region.

At the same time, an academic and policy interest in the idea of HQD started and gained prominence in China and other rapidly developing economies. Researchers pointed out that the increase of GDP alone could not take into consideration the multi-dimensional character of development (Sen, 1999; Stieglitz, Sen & Fitoussi, 2009). This has resulted in the rise of indices like HQDI where innovation, sustainability, equity and openness are some of the major dimensions (Zhou, 2010).

At around the same time CO_2 emissions became a major issue in the development debate. Kyoto Protocol (1997) and later Paris Agreement (2015) mounted additional pressure on nations to charge the economy to environmental degradation dissociation. The studies of the twenty-first century focused on the environmental and monetary price of industrialism and urbanization, particularly the fast-growing areas, such as South Asia (Stern, 2007).

The historical significance of control variables in this study is also great. Population growth has had varied impacts in the developmental discourse, but most of it is a two-edged sword. Whereas demography dividend is a promise to economic growth, excessive population growth especially in South Asia has resulted into straining infrastructure, education and even environment (Bloom & Williamson, 1998). Similarly, GDP as a common measurement of economic wellbeing since 1940s has been even more questioned because it does not take the aspect of sustainability and equity into account (Sen, 1999). Lastly,

the part of Renewable Energy Consumption became more explicit since the late 2000s when the climate change became a part of policy mainstream.

In the 2020s, the nexus of the three factors, DFI, HQDI, and CO_2 emissions became a subject of practical investigations. Due to the growing interest in sustainable development, the role of digital finance, which has been previously available as one of the levers of economic inclusion, is no longer simply a lever to inclusive growth but a potential driver (or a risk) to environmental sustainability contingent on the extent to which a future digital infrastructure ends up being energy-intensive (Zhang et al., 2022; Sadorsky, 2023). This historical trend highlights the increasing interest in examining the sophisticated channels, through which digital financial systems influence the quality of development as well as their environmental consequences and the chosen control variables are core to this shift in particular across South Asian economies to the dynamics of modernization, climate risks, and social equity.

DFI that offers imaginative means of bridging the current between the low-income communities and the formal financial sector has demonstrated its significance in the modern development policy (Dinh Le Quoc et al., 2024). DFI implements the use of mobile banking, electronic wallet, agent banking, and fintech to deliver financial services to the underserved communities in South Asian economies where the traditional banking system structure is often scarce or non-existent (Demirgüç-Kunt et al, 2022). DFI reduces operation expenses, increases the efficiency of transactions and ensures financial instruments are accessible to excluded and distant populations of people through digitalization of credit, insurance, savings, and payments. (Hussain et al., 2023) state that the effects of DFI can be observed beyond the improvement of accessibility; it leads to the transformation of the quality of financial involvement.

Many researchers have taken an extensive use of Digital Financial Inclusion (DFI) as a central variable to determine its output on economic growth, financial equality, and sustainability. Indicatively, a study by Xi and Wang (2023) explored the contribution of DFI to the standard of economic expansion by developing a panel data model at the provincial level in China in an attempt to measure local imbalances and spatial spillover impacts. Shahzad et al. (2024) created a composite DFII based on the PCA of five indicators, such as ATMs, bank branches, institutions, outstanding loans, and deposit holdings as the percent of GDP, to understand the influence of DFI on green innovation in the South Asian economies

High-quality development a developmental perspective of DFI would be creating direct support to social inclusion, innovation, and planned development, being parts of high-quality development Xi & Wang (2023). It enhances enterprise and reduces regional and gender inequalities by simplifying the ability of SMEs and informal enterprises to avail finance, particularly enterprises owned by women or ones based in rural communities (GSMA, 2022). Digital finance contributes to solving one of the key issues of sustainable development, poverty reduction, and even income distribution, by adding marginalized groups to the formal economy. In addition, the digital footprint produced by financial inclusion allows governments to better target policies and monitor socioeconomic realities in real-time because it improves the quality of institutions and their governance structures (Liu et al., 2023).

Different researchers who have used it in various policy and economic context have applied the High-Quality Development Index (HQDI). As an example, Xi and Wang (2023) built HQDI based on five dimensions innovative, coordination, green development, openness and sharing to gauge the quality of the economic growth and used it to understand the contribution of digital financial inclusion in China. In assessing the role of green finance and digital innovation on sustainable development, Zhang et al. (2022) used HQDI. In a like manner, Lin and Wang (2021) have utilized the concept of HQDI to study the issues of regional development quality and regional inequality in china that served as the multidimensional measure to present the performance to meet sustainable development goals.

The need to fulfill the digital transformation process that is currently happening in the entire South Asia territory and the current direction of the digital finance that coincides with the achievement of the goals for sustainable development, including gender equality, decreasing poverty, and inclusive economic growth, it is apparent that the DFI is a vital part of the high-quality development. To enable countries to achieve inclusive and sustainable economies in the post-pandemic world, it helps level off regional

disparities, enhance innovation, assist in mobilizing the empowerment of marginalized population groups, and reinforce institutional and financial resilience.

Hypothesis 1: Digital Financial Inclusion positively affects High Quality Development Index.

Zhang et al. (2022) focused on CO_2 as an intermediate variable between green finance and sustainable development, as such digital financial services amount to both fanning the flames of pressures, on the one hand, and minimizing them, on the other hand, depending on energy sources used. Moreover, adding CO_2 emissions as a mediating factor of the DFI and HQDI relations, Xi and Wang (2023) used a Sobel test to show how the emissions can moderate developmental advantages of DFI.

Reducing CO_2 emission helps in the long-term sustainability and ecological balance, which are directly correlated to the objectives of HQD. Technological innovation is one of the fundamental principles of HQDI as it is implemented through investments into cleaner technologies, renewable energy, and energy-efficient industrial processes, besides reducing emissions (Zhang et al., 2022). Similarly, decoupled growth linked to carbon-intensive production facilitates the coordinated development in the region, as the development of different regions and industries does not put excessive pressure on the environment (Lin & Wang, 2021). On the social dimension, less emissions of CO_2 makes the places of living much healthier and decreases problems and enhances the quality of the air, all of which contributes greatly to the areas of social well-being which is another element of HQDI (Sen, 1999). As such, the incorporation of carbon management policies in the national development plans is very important to improve the fight against climatic changes and, at the same time, it is an important tool in reaching the goals of the balanced, equitable and developmental economic growth in South Asia.

Stern (2007) has pointed out that market-based instruments can be very instrumental when used alongside the environmental regulations in the process of cutting down carbon emissions. Pay-as-you-go mechanisms in the energy sector and more user-friendly digital climate finance can also help DFI in speeding up public and private investments in smart energy systems and green infrastructure in South Asia (Lin & Wang, 2021). Even though DFI has positive effects on the environment, it is crucial to understand that, in the absence of a green energy transition, it may increase emissions due to the rising demand for digital infrastructure. Examining the changing relationship between digital finance and environmental outcomes is crucial given its dual potential as a carbon emission contributor and mitigating factor.

Hypothesis 2: Carbon emissions mediate the relationship the relationship between DFI and HQDI, indicating that DFI both positively and negatively depending on its environmental impact in South Asian Economies.

Methodology

In this chapter we provide the information to reader to explore the effect of DFI on the HQDI under the mediating influence of CO_2 emissions in case of South Asian economies, it is in this section of the study where emphasis is made on what the research technique employed is which would entail the description of the variables, research sources, specification of the research model as well as the analysis method, of data. To illustrate this effect of DFI on the quality of development, panel data of nine South-Asian economies have been collected within the framework of 2013-2023 to capture the influences on the overall quality of development as either a dependent variable, as well as conditions of the environment and economic factors such as GDP, population growth, and renewable energy consumption as the control variables.

We gathered secondary data for this research from the World Bank, Global Findex Database, and IMF. These websites are authentic and reliable source for achieving accurate result. We were able to obtain validated data that could yield generalizable, unquestionable and solid result. The research determines empirically the relation between DFI and the HQDI. The research design in the study entails panel data analysis of nine economies in the South Asian region over a time span of eleven years, between 2013 and 2023.

Research is primarily quantitative in nature. The purpose of this study is to provide the validity of the proposed hypothesis with empirical results. The report tests the direct or indirect effects of DFI on HQDI with the emissions of CO_2 as a mediating variable using a Sobel test and a fixed effects panel regression and the mediation analysis.

Table 1

Operationalization of Variables

Variable	Dimension	Acronym	Operationalization	Source
Digital Financial Inclusion Index	ATMs, Branches, Institutions, Loans/GDP, Deposits/GDP	DFII	Principal Component Analysis (PCA) of financial inclusion indicators	IMF, Global Findex, WB
CO_2 Emissions	CO_2 emissions per capita (metric tons)	CO_2	Used in mediation analysis (Sobel Test)	WDI (2021)
High-Quality Development Index	Composite index based on five dimensions	HQDI	$\text{HQDI} = \sum_{i=1}^{5} (w_i \times I_i)$	WDI; Xi & Wang (2023)
Population Growth	Annual population growth rate (%)	PG	Annual percentage increase in population	WDI (2021); Sadiq et al.
GDP	Annual percentage growth of GDP	GDP	Yearly GDP growth rate (annual %)	WDI (2021); Sadiq et al.
Renewable Energy Consumption	% of total final energy consumption	REC	Share of renewable energy in final energy use	WDI (2021); Sadiq et al.

Base Line Equation

The baseline equation for the relationship between High Quality Development Index (HQDI) and its independent variables, DFI and control variables (CV) can be written as follows:

$$HQDI_{it} = \beta_0 + \beta_1 DFII_{it} + \beta_2 CO_{2it} + \beta_3 REC_{it} + \beta_4 PG_{it} + \beta_5 GDP_{it} + \varepsilon_{it}$$

Where,

$HQDI_{it}$: The High Quality Development Index of entity i at time t.

$DFII_{it}$: Digital financial inclusion index of entity i at time t.

CO_{2it}: CO_2 Emission of entity i at time t.

REC_{it}: Entity i consumption of renewable energy at time t.

PG_{it}: Population Growth of entity i at t.

GDP_{it}: Entity i GDP at time t.

β_0: Intercept (constant).

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$: Coefficients representing the effect of each independent variable on the dependent variable.

ε_{it}: Error term for entity *i* at time *t*.

The study employs panel data to explore the relationship between the DFII and the HQDI of nine South Asian states of the period of 2013-2023. The mediating variable is taken to be CO_2 emissions. It is appropriate in the studies of cross-time changes and cross-country differences since it combines a cross-sectional and time-series facet. There is also the added benefits of the panel data which results in more degrees of freedom and reduces multicollinearity; bringing greater strength to the analysis. They are both fixed effects and random effects and a best model selected based on Hausman test. With the consideration of control variables, such as GDP, population growth, and utilization of renewable energy, this methodology assists in reaching the goal of the research, which is to determine the direct and indirect impact of DFII on HQDI through the CO_2 emissions.

Data Analysis

In this chapter, an in-depth analysis of the information given in the previous chapters is given. It writes on the effects of DFI on HQDI, on its five major measurements of Innovation, Coordination, Green, Open, and Sharing. It is constructed on research methodology presented in Chapter 3. The mediating effect of CO_2 emissions and that of the controlling variables, such as GDP, population growth, and consumption of renewable energy are investigated too. The empirical analysis has been undertaken using a panel data of selected South Asian countries. This chapter discusses panel data regression techniques, correlation matrices and descriptive statistics. It tests the integrity of the specified econometric models, give intricate accounts of the estimation procedures and gives the empirical findings that either favor or rip off the hypotheses advanced.

Table 2

Descriptive statistics

	Mean	Maximum	Minimum	Std. Dev.	Observations	LLC
CO_2	2.196	8.70	0.200	2.448	99	4.659**
DFII	25.644	93.90	0.700	23.978	99	4.301**
GDP	3.897	37.50	-32.9	6.611	99	-4.842**
HQDI	1050.176	9584.80	15.10	1986.360	99	2.840**
PG	1.321	3.600	1.125	1.013	99	2.460**
REC	37.519	86.00	0.900	27.801	99	3.856**

Table 1 gives a breakdown of the descriptive statistics of the study variables with 99 observations that illustrates the average, the standard deviation, the minimum and the maximum of any variable. The mean of Digital Financial Inclusion Index (DFII) is found to be 25.64 with high standard deviation of 23.97 that is having a range of 0.7 to 93.9 that implies that there is a wide disparity in effects of digital financial access and usage amidst South Asian countries. High-Quality Development Index (HQDI) describes an average of 1050.17 with a large standard deviation of 1986.36 at values of 15.1 to 9584.8 indicating that there is a significant difference in development levels. CO_2 emissions have moderate variation intervals with the mean being 2.19, standard deviation being 2.44 and the range spans between 0.2 and 8.7 that indicates variations in the environmental impacts of the countries. The economic diversity of GDP according to the means of 3.89, with large dispersion (SD = 6.61) is observed with the lowest value being -32.90, and the highest being 37.50. Population Growth (PG) indicates the stable trends on demographic characteristics, the Renewable Energy Consumption (REC) has a huge range across the dataset, a mean of 37.52, SD 27.80 and a range of 0.9 to 86.0. In addition, the Unit Root Test, Levin, Lin, and Chu technique reveals that all the variables are at stationarity level, because all the null hypotheses (no unit roots) are rejected at the 5% level, meaning that the data are stable to undergo further econometrics analysis.

Table 3

Correlation Analysis

	CO_2	DFI	GDP	HQDI	PG	REC
CO_2	1					
DFI	.566**	1				
GDP	.040	-.007	1			
HQDI	.218*	.208*	.118	1		
PG	.086	-.157	-.014	-.118	1	
REC	-.569**	-.246*	-.024	-.193*	-.519**	1

According to Table 3, the coefficients of correlation between the most significant variables of the research, a number of correlations should be mentioned. There is a high positive correlation between DFI and the CO_2 emission ($r = 0.666$, $p < 0.01$), which implies that rising digital financial activity can possibly cause

greater carbon emission, perhaps as a result of industry or economic growth. In the same sense, there is a positive relationship between DFI and HQDI showing that it can work towards attaining broad-based development goals. In contrast, it shows a negative and significant connection between DFI and Renewable Energy Consumption (REC), so a higher level of digital access in the studied economies may also be associated with reduced use of renewable energy. There is also a strong and negative relationship between REC and CO_2 emissions that means that countries that make use of renewable energy have been known to contribute fewer emissions. In addition, CO_2 emissions and HQDI are positively linked, pointing towards a potential trade-off in which developmental benefits are at the expense of the environment. The statistics further shows a strong negative relationship between the two variables that is the HQDI, and REC, which adds weight to the energy-development trade-off story. There is a strong and negative correlation between Population Growth (PG) and REC and this implies that fast growing populations are likely to be limited in adopting renewable energy. The statistically insignificant correlation of GDP with the key study variables depicts the weaker linear relationships through correlation. Noteworthy, the correlation matrix shows that there are no correlation coefficients of independent variables above 0.80, which means that there are no serious questions of multicollinearity among the variables in the model.

Regression Analysis

Table 4 shows the outputs of fixed effects panel regression model where High-Quality Development Index (HQDI) is regressed with Digital financial inclusion (DFII), Population Growth (PG), GDP, Renewable Energy Consumption (REC), and CO_2 emissions (CO_2). By means of the table above, the results can be summarized. Fixed effects were chosen using the Hausman test that implies that the model can be applied to correct the unobserved heterogeneity over time as well as between countries (Sadiq et al. 2024)

Table 4

Regression Analysis

Variables	HQDI	Statistic	Value
	Coef.		
DFII	0.5012**	Adjusted R-square	0.3943
	(0.1696)	Durbin-Watson stat	2.1305
PG	-50.1000**		
	(16.6372)	Hausman test	0.0000
GDP	3.6040*	F- Statistic	0.0000
	(1.9589)		
REC	-3.9807**		
	(0.9160)		
DFII ⟶ CO_2	8.7912**		
	(0.4233)		
C	7.8479**		
	(0.6790)		

Standard errors in parentheses

** p<0.05, * p>0.05

DFII coefficient is positive and statistically significant and indicating that high-quality development is positively affected by digital financial inclusion. This concurs with previous studies demonstrating that DFI enables a more open and coordinated development, particularly in the developing countries, and promotes finances access and innovation (Xi & Wang, 2023; Demirgüç-Kunt et al., 2022). Population Growth shows a positive and statistically significant effect on HQDI, suggesting that higher population growth contributes to development in South Asian economies. This may be attributed to the role of population expansion in enlarging the labor force, creating market size advantages, and encouraging productivity improvements when effectively managed (Bloom & Williamson, 1998; Lin & Wang, 2021). My theory that the greater amount of economic activity results in positive developmental outputs is also supported by the positive, just barely at 0.05 significant association of GDP and HQDI. This finding is

sustainable to the endogenous growth theory where long run growth is traced to evolution of human capital, investment, and innovation (Romer, 1990; Schumpeter, 1934). The higher GDP increases fiscal capability of investments in sustainability, health and education. As is remarkable, it has a negative correlation with HQDI; the relationship is statistically significant. The possibility of such a surprising finding may be related to trade-offs associated with switching to renewable energy, namely, high initial investments or a poorly implemented use in developing countries (IRENA, 2023). Sobel test was applied to test the mediating impact of CO_2 emissions on the association between HQDI and DFII. The test provided a Z-value of 3.188 that is greater than the 1.96 critical value indicating that the mediation effect is statistically significant at 1 percent level ($p < 0.01$). The mediation value of 1.2912, which is statistically significant, shows that CO_2 emissions serve as a mediating variable between DFI and the HQDI. This implies that while digital financial inclusion directly enhances HQDI, it also indirectly affects it by increasing CO_2 emissions through higher energy use, ICT infrastructure expansion, and digital transactions. Thus, the pathway "DFI → CO_2 Emissions → HQDI" is statistically significant, emphasizing that environmental externalities play a crucial role in shaping development outcomes and that the environmental costs of digital financial inclusion must be managed to ensure sustainable high quality development (Trabelsi & Fhima, 2025). The constant or intercept that shows the baseline value of HQDI using the zero values of the explanatory variables is not insignificant. At Adjusted R2 score of 0.3943, the model has a good explanatory ability with approximately 39.4 percent in the variability of HQDI. The Hausman test confirms the validity of the choice of the fixed effects model. Importantly, the 32 Durbin-Watson statistic is 2.1305, which lies close to the ideal value of 2, indicating no serious autocorrelation problem in the residuals. In summation, the general model is statistically significant, which can be seen in the F-statistic (Baltagi, 2021).

Conclusion

In this study, the authors critically checked the influence of Digital Financial Inclusion (DFI) on the High-Quality Development Index (HQDI) in nine countries of South Asian countries between 2013 and 2023. The research proved the influence of digital access to financial services on the multifaceted development outcomes, such as social sharing, innovation, coordination, openness, and green development. Moreover, it also added, CO_2 emissions as a mediating variable, since, in spite of turning around the digitalization of finance to achieve the efficiency of the institutions and inclusion in the economy, there are possibilities of raising the energy demand and incurring environmental cost. To know the function of technology-fueled financial inclusion as a means of achieving long-term sustainable development, this study relied on the Endogenous Growth Theory as a background. Three hypotheses were tested: H1 and H2, the hypothesis stated that there is the direct positive correlation between DFI and HQDI, a significant correlation between CO_2 emission and HQDI, and the significance of influence of DFI on CO_2 emission respectively.

The data was analyzed using Fixed Effects panel regression model since its results were appropriate according to the results of the Hausman test. The mediating effect of DFI on CO_2 emissions was also analyzed using mediation analysis and the Sobel test being statistic measures of the results credibility, including an adjusted R2 and F score. It was controlled over population growth, GDP, and the renewable use of energy. The findings indicate that the high significant positive relationship between DFI and HQDI is partly mediated by CO_2 emissions. It means that on the one hand, digital finance fosters an all-encompassing growth; on the other hand, it can lead to environmental problems that have to be integrated into the policy, which makes CO_2 emissions an important second-order factor.

The research contributes to the material of literature by demonstrating how sustainability and digital access are becoming more and more linked to the standard of economic expansion. Policymakers should use DFI as a strategic tool to promote innovation, equity, and green transformation in addition to providing financial access. Furthermore, by concentrating on South Asian nations, a region with distinct developmental limitations, uneven digital infrastructure, and varied environmental conditions that this research fills a large gap in the literature.

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