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EXPLORING THE LINK AMONG FINANCIAL INCLUSION, ECONOMIC GROWTH, TAX REVENUE AND ENVIRONMENTAL DEGRADATION IN DEVELOPING COUNTRIES: A STUDY ALIGNED WITH SDG 8 AND 13

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ABSTRACT

This study examines the link among financial inclusion, economic growth, tax revenue and CO2 emission in 87 developing countries. Secondary data has been used for the analysis over 2005 to 2020. CO2 emission is used as dependent variable while, financial inclusion, economic growth and tax revenue is using as explanatory variables. Labore force participations and foreign direct investment are used as control variable. Novelty of the study is to consider combined impact of productions, service and consumption-based factors. This study has been uses descriptive statistics, correlation matric and fixed affect model to analyze the data. The results of descriptive statistics show the intertemporal properties of the data which shows that data is normally

distributed and there is no outlier in the data. Correlation matrix shows that there is no multicollinearity issue in data. Results of Hausman test shows that fixed effect model is most appropriate for the analysis rather than random effect model. Results of fixed effect model shows that financial inclusion, economic growth, tax revenue and foreign direct investment has positive and significant impact on CO2 emission except economic growth while, labore force participation has negative impact on CO2 emission. Which shows that developing countries should focus on improvement of environmental sustainability awareness to the individuals and industrialists as well so that the environmental degradation should be controlled. It is also important for the developing countries to develop and implement the policies and standard environmental standard which are very helpful to control the environmental degradation.

Keywords: financial inclusion, economic growth, tax revenue, CO2 emission, Fixed affect, Environmental sustainability

INTRODUCTION

Environmental degradation and sustainable growth are the two main problems faced by the world now days especially in developing countries. For achieving sustainable development goals 2030 financial inclusion is known as the best way for developing strategies as well. It is also considered very helpful in achieving eight sustainable goals (SDG's) out of 17. Clean and sustainable environment is the major concern of every economist, policy maker and researcher as well. They are trying to explore each determinant of environmental degradation. Empirical studies highlight that financial development is key to boost the economic progress and it reduce the pollution in environment (Le et al., 2019; Shah & Ali, 2022). Financial inclusion provides foundations for financial development which further raise the advancement in financial sector as well as enhance the institutional progress. The concept of financial inclusion emerges since early 2000's while before its financial exclusion was used as a major cause of poverty (Chibba, 2009). Financial inclusion is considered to provide equal and easy access of financial products and services to the financially deprived individuals and businesses (Shah & Ali, 2023; Demirgüç-Kunt et al. 2020; Sarma, 2008). Greater, Easy and affordable access of financial products and services is whispered accelerate the economic progress and overcome the income discrimination by providing equal and affordable chances to all individuals and business. It is also considered

the basic indicator of financial and well as economic stability (Fouejieu et al. 2020). As the financial inclusion plays a crucial role in promoting economic condition, it can also affect the environmental quality (Feng et al. 2022). It is also observed that higher degree of financial inclusion can be expected to enhance the capital formation, which is directly linked with the consumption pattern of individuals and business as well. It can be the reason of increased in the demand for energy consumption which is linked with the environmental quality. To check this impact various studies has investigated the relationship among environment sustainability and financial inclusion across the globe (Shah & Ali, 2023; Lee et al. 2020; Renzhi & Baek, 2020; Zaidi et al. 2021).

In recent era increasing energy demand is fulfilling by combustion of fossil fuels across the world which is the great cause of climate change. The extensive use of fossil fuel in automobiles, power plants, machinery and houses are frequently contributing in the overall human-made emission of CO2 emission (Dong et al., 2020). Meanwhile, many countries have taken serious steps to control the emission of corban intensity, so that the environmental suitability can be achieved (Banna, & Alam, 2020; Nawaz, 2019; Zaidi et al., 2019; Hussain et al. 2023; and Khan et al. 2022).

The ultimate objective of this study is to examine the impact of financial inclusion on CO2 emission in developing countries. Because developing countries are continuously trying to raise their economic activities to achieve higher degree of economic progress. To achieve this higher level of economic progress finance is playing vital role which can be arranged from tax revenue as higher labore force participations. That's why this study is focusing on financial inclusion, tax revenue, foreign direct investment and economic growth to examine the CO2 emission in developing countries. there is hardly any study which examine this type of relationship for developing countries.

LITERATURE REVIEW

The existing body of literature offers valuable insights into the roles of globalization and renewable energy in mitigating CO2 emissions. However, the literature largely overlooks the potential impacts of financial inclusion in this context. To provide a comprehensive understanding, the literature regarding the relationship between financial inclusion and CO2

emissions is highlighted in this study. While, previous studies extensively document the economic growth effects of financial inclusion (Huang et al. 2021; Kim et al. 2018), research on its connection to environmental quality remains relatively scarce. Among the limited studies that have investigated the link between financial inclusion and CO2 emissions.

Le et al. (2020) investigates through a study involving 31 Asian countries over the period of 2004-2014. This study constructs a financial inclusion index using three composite indicators through principal component analysis and employed Driscoll-Kraay standard errors for linear panel models. The findings indicated that financial inclusion, alongside other controlled variables such as national income level, urbanization, industrialization, energy consumption, and foreign direct investment, contributes to increased CO2 emissions in the selected countries.

Renzhi and Baek, (2020) examine the effectiveness of financial inclusion in mitigating CO2 emissions. They utilized an annual panel dataset spanning from 2004 to 2014 and applied a generalized method of moments (GMM) model for regression analysis. The results provided evidence that financial inclusion serves as a measure to reduce CO2 emissions in the countries under scrutiny. Furthermore, the authors argued that promoting financial inclusivity can help mitigate the adverse environmental impacts of economic growth, thereby restoring environmental welfare.

Zaidi et al. (2021) conduct a recent study focusing on the Organization for Economic Cooperation and Development countries during the period of 2004-2017. They employed the dynamic common correlated effects estimator to examine the dynamic effects of financial inclusion on CO2 emissions. The results suggested that higher levels of financial inclusivity were associated with lower levels of CO2 emissions in both the short and long term.

While the examination of CO2 emission impacts resulting from financial inclusion remains limited in the existing studies, previous research has provided mixed evidence regarding the relationship between Financial Stability and CO2 emission levels worldwide. Several studies have documented varying findings in this regard. For instance, Zhao et al. (2022) found that Financial Stability promotes CO2 emission abatement among Chinese provinces. Similarly, Odhiambo (2020) asserted that Financial Stability complements CO2 emission-abatement

policies in selected Sub-Saharan African (SSA) nations. Conversely, Wang et al. (2020) demonstrated that Financial Stability contributes to increased CO2 emissions in G7 countries.

In a comparative analysis of the environmental impacts of Financial Stability in developed and developing economies, Shoaib et al. (2020) argued that while Financial Stability exacerbates CO2 emission levels regardless of a country's economic status, the adverse environmental effects are relatively more pronounced in developed nations. As financial inclusion encompasses components that can facilitate financial sector development, it is crucial to examine the robustness of findings from previous studies that have explored the link between Financial Stability and CO2 emissions using the outcomes of the present study.

From the literature reviewed in the previous subsections, several gaps can be identified. Firstly, it is evident that the majority of existing studies have focused extensively on examining the impacts of Financial Stability on CO2 emissions. However, only a limited number of recently published studies have explored the relationship between financial inclusion and CO2 emissions.

The literature gaps identified in the preceding sub-sections reveal several important points. Firstly, no previous study has investigated the impact of financial inclusion on CO2 emissions using a panel data set specifically focused on developing countries. This highlights the need for research in this area. Secondly, while existing studies have extensively examined the effects of renewable energy consumption, particularly primary renewable energy resources, there is a lack of research on the link between financial inclusion, tax revenue, economic growth and CO2 emissions. This study aims to address these literature gaps by employing relevant data and econometric methods to examine the case of the developing countries.

THEORETICAL FRAMEWORK

The ongoing discourse surrounding financial inclusion primarily revolves around the understanding that inclusive financial systems are designed to reduce poverty by stimulating economic growth (Beck et al., 2007; Makina and Walle, 2019). However, the effects of financial inclusion are complex, leading to a new debate within the framework of sustainable development goals. Therefore, it is crucial to consider the theoretical perspectives related to carbon emissions when predicting the policy directions that will drive efforts in financial inclusion.

Financial sector innovations have the potential to expand cross-border investments and provide greater access to energy-efficient goods and advanced technology. These technological advancements contribute to environmental sustainability by promoting the efficient use of energy and reducing pollution levels in countries. However, financial inclusion can also have adverse environmental impacts. For instance, financial growth may encourage consumers to borrow money for purchasing luxury goods such as homes, air conditioning, refrigerators, cars, and washing machines, leading to increased emissions. Additionally, financial growth may reduce the cost of financial resources for companies, allowing them to establish more factories, expand their operations, and acquire additional equipment and machinery, thereby further exacerbating emission levels (Sadorsky, 2010).

Hence, it is essential to examine the impact of financial inclusion on carbon emissions in developing countries. Usman et al. (2020) recently investigated the role of financial inclusion in determining the ecological footprint in the top 15 carbon emitting countries. However, it is worth noting that their study utilized the traditional index of financial development, potentially misrepresenting the concept of financial inclusion. Nevertheless, studies focusing on financial inclusion and its environmental effects remain scarce.

The relationship between financial inclusion and carbon emissions has also been explored through the lens of the environmental Kuznets curve perspective. The EKC, developed by Grossman and Krueger, (1995), suggests that in the early stages of development, environmental degradation may occur, but as economies progress, the benefits of economic growth can be utilized to protect the environment.

Renzhi and Baek, (2020) recently investigated the causal relationship between carbon emissions and financial inclusion using the concept of the environmental Kuznets curve. They found that this relationship can exhibit a non-linear pattern depending on the characteristics of the country. Similarly, Shahbaz et al. (2013) studied the data of Malaysia and discovered clear evidence of a non-linear link between financial stability and CO2 emissions. This study also suggests a non-linear association between financial inclusion and CO2 emissions.

DATA

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This study is using panel data of 87 countries for 2005 to 2020. The data is taken from the world bank dataset, international monetary fund and ministry of finance of every country.

ECONOMETRIC MODEL

$$CO2_{it} = \beta_0 + \beta_1 FI_{it} + \beta_2 EG_{it} + \beta_3 FDI_{it} + \beta_4 LFPR_{it} + \beta_5 TR_{it}$$

CO2= Carbon Dioxide Emission

FI= Financial inclusion

EG= Economic growth

FDI= Foreign direct investment

LFPR= Labor force participation

TR= Tax revenue

β = Coefficient

I= Countries

T=Time

Table 1

Variable	**Description**
CO2	CO2 Emission measured as per capita
FI	Financial Inclusion measured with the help of index covering availability, access, usage dimensions
EG	Economic Growth Annual measure as percentage
FDI	Foreign Direct Investment, measure as percent of GDP
LFPR	Labor force participation rate
TR	Tax revenue, measure as percent of GDP

ECONOMETRIC METHODOLOGIES

To investigate the impact of selected independent variables on dependent variables for selected developing countries from 2005 to 2020 following estimation techniques has been applied. Firstly, this study used descriptive statistics for check the measure of dispersion in the data furthermore this test shows the normality of data. Secondly this study used correlations matrix develop by Pesaran and Smith (1995) and later on amended by Chudik and Pesaran (2015). Thirdly, this study implements Hausman to select the appropriate model for estimation from fixed and random effect models.

RESULTS AND DISCUSSIONS

DESCRIPTIVE STATISTICS

Table 2 shows the results of descriptive statistics which shows the intertemporal properties of the data. the descriptive statistics indicate a dataset with varied and often skewed distributions across the different measures. Particularly notable are the variables for FDI, tax revenue, and economic growth, which show significant variability and skewness, suggesting that a small number of observations (countries) may have very different characteristics compared to the rest. This is important to consider for any further analysis, as the presence of outliers or a non-normal distribution can affect the results and interpretations of inferential statistics. Results further shows that the average financial inclusion index is 23.54 with a standard deviation of 9.22, indicating moderate variability in financial inclusion across the observations. The average rate is approximately 59.81, with a range from 25.25 to 88.6, suggesting varying levels of labor force participation across different countries. On average, FDI as a percent of GDP is 4.35, with a relatively high standard deviation of 5.05, indicating significant disparity among countries' FDI levels. The average tax revenue is 16.15% of GDP, with countries ranging from 0.62% to 58.98%.

TABLE 2 DESCRIPTIVE STATISTICS

	CO2	EG	FDI	FI	LFPR	TR
Mean	2.636830	2.086607	4.350870	23.53567	59.81712	16.15500
Median	1.850000	2.530000	3.070000	23.16000	60.58000	15.18000
Maximum	15.34000	96.96000	43.91000	51.50000	88.60000	58.98000

Minimum	-6.820000	-34.78000	-37.17000	3.530000	25.25000	0.620000
Std. Dev.	2.527973	5.655496	5.050401	9.224314	10.80483	7.158834
Skewness	1.937126	3.096132	2.010844	0.143132	0.100312	1.669569
Kurtosis	8.083703	65.62225	16.84801	2.584833	2.572678	9.433248
Jarque-Bera	2367.822	229508.7	12051.93	14.73938	12.91628	3044.929
Probability	0.000000	0.000000	0.000000	0.000630	0.001568	0.000000
Sum	3667.830	2902.470	6052.060	32738.12	83205.62	22471.60
Sum Sq. Dev.	8883.000	44458.64	35454.10	118272.3	162274.6	71235.97
Observations	1391	1391	1391	1391	1391	1391

CORRELATION MATRIX

Table 3 shows the results of correlation matrix which shows the degree of association among selected dependent and independent variables. Results further shows that the most significant finding here is the strong positive correlation between Financial Inclusion Index and CO2 emissions, which suggests that as financial inclusion increases, so do CO2 emissions. This could be due to the fact that increased financial inclusion may lead to greater economic activity and, consequently, higher emissions. Conversely, the negative correlation between Labor Force Participation Rate and CO2 emissions, though weak, is still significant and could indicate that higher employment may be associated with industries or activities that are less carbon-intensive or that more employed individuals may lead to more efficient economies and less pollution. The other variables show weak or insignificant correlations with CO2 emissions, suggesting that they may not have a strong direct linear relationship with environmental degradation as measured by CO2 emissions. It's important to note that correlation does not imply causation, and these relationships can be influenced by various confounding factors. Additionally, the significance of

the correlation does not measure the effect size or the practical importance of the relationship**.** Furthermore, results shows that there is of multicollinearity issue in data.

TABLE 3 CORRELATION MATRIX

Correlation Probability	**CO2**	**EG**	**FDI**	**FI**	**LFPR**	**TR**
CO2	1.000000					
EG	0.047284 0.0779	1.000000				
FDI	0.099307 0.0002	0.148577 0.0000	1.000000			
FI	0.565201 0.0000	0.010923 0.6840	0.202297 0.0000	1.000000		

LFPR	-0.137891	0.021036	-0.013428	-0.290366	1.000000	
	0.0000	0.4331	0.6168	0.0000		
TR	0.022724	-0.055554	-0.003912	0.145005	-0.056706	1.000000
	0.3971	0.0383	0.8841	0.0000	0.0345	

HAUSMAN

Table 4 shows the results of Hausman test which is a statistical test that is commonly used in panel data analysis to choose between a Fixed Effects (FE) model and a Random Effects (RE) model. The choice between these two models is crucial because it determines how you treat the individual-specific effects in your analysis. The Hausman test examines the null hypothesis that the preferred model is the Random Effects model against the alternative hypothesis that the preferred model is the Fixed Effects model. based on the Hausman test results, you should proceed with the Fixed Effects model rather than the Random Effects model for your panel data analysis. This decision is crucial as it ensures that the model you use produces consistent and unbiased estimators.

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TABLE 4 HAUSMAN

Hausman Test			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	19.197338	5	0.0018

FIXED EFFECT MODEL

The table 5 presents the results of a fixed effects regression model with CO2 emissions as the dependent variable. The model includes several independent variables: Economic Growth (EG), Foreign Direct Investment (FDI), Financial Inclusion (FI), Labor Force Participation Rate (LFPR), and Tax Revenue (TR). The coefficient is not statistically significant at the above 5% level ($p > 0.05$). This implies that economic growth does not have a statistically significant impact on CO2 emissions in this model. The relationship between economic growth and environmental impact is complex and might be mediated by other factors not captured in the model. FDI is statistically significant at the 5% level ($p < 0.05$). The positive coefficient shows that an increase in FDI is associated with an increase in CO2 emissions. This could reflect the fact that FDI might be directed towards sectors with higher emissions. FI is highly significant ($p < 0.05$). The positive coefficient indicates a strong relationship between financial inclusion and CO2 emissions, shows that higher financial inclusion is associated with increased emissions. This might be due to increased economic activity and consumption resulting from greater access to financial services (Le et al. 2020; Zaidi et al. 2021; Usman et al. 2021). LFPR is not statistically significant ($p > 0.05$). This suggests that the labor force participation rate does not have a clear-cut impact on CO2 emissions in this model. TR is statistically significant at the 5% level ($p < 0.05$). The positive coefficient shows that higher tax revenue is associated with increased CO2 emissions. This might be an indicator of larger government size and spending, potentially leading to more emissions-intensive activities. The F-statistic is highly significant, indicating that the model is statistically significant and better at explaining the variance in CO2 emissions than a model without any predictors.

The model shows a strong overall fit, but the significance of individual predictors varies. The significant positive relationship of FII and FDI with CO2 emissions indicate that financial and

investment activities are associated with environmental degradation. This aligns with the narrative that economic and financial development, without proper environmental regulations and sustainable practices, can lead to increased pollution (Zaidi et al. 2021). The insignificance of EG and LFPR might point to the complexities of these relationships and the potential for other mediating factors. The positive coefficient for tax revenue might shows that government activities, as measured by tax revenue, are not always aligned with environmental conservation, underscoring the need for policy measures that target sustainable development.

TABLE 5 FIXED EFFECT MODEL

Dependent Variable: CO2				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EG	0.001054	0.003386	0.311252	0.7557
FDI	0.012386	0.004762	2.600908	0.0094
FI	0.060330	0.007181	8.401128	0.0000
LFPR	-0.006673	0.007375	-0.904828	0.3657
TR	0.017492	0.006184	2.828473	0.0047
C	1.277406	0.463590	2.755465	0.0059
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.936025	Mean dependent var		2.636830
Adjusted R-squared	0.931544	S.D. dependent var		2.527973
S.E. of regression	0.661423	Akaike info criterion		2.075004
Sum squared resid	568.2867	Schwarz criterion		2.421428
Log likelihood	-1351.165	Hannan-Quinn criter.		2.204546
F-statistic	208.8563	Durbin-Watson stat		0.699653
Prob(F-statistic)	0.000000			

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CONCLUSIONS AND POLICY SUGGESTIONS

CONCLUSIONS

This study contributes to the understanding of the intricate relationship between financial inclusion and environmental sustainability, particularly focusing on CO2 emissions. The empirical analysis, grounded in a robust theoretical framework, reveals that financial inclusion, as measured by the Financial Inclusion (FI), significantly influences CO2 emissions. The fixed effect regression model indicates a positive relationship between financial inclusion and CO2 emissions, corroborating the notion that greater access to financial services and products may inadvertently lead to increased energy consumption and CO2 emissions, particularly in developing countries where environmental regulations may be less stringent or enforced. The findings align with the theoretical assertions that financial growth, while catalyzing economic development, may also increase consumer spending on emission-intensive goods and facilitate industrial expansion, contributing to higher CO2 emissions (Sadorsky, 2010). This is particularly evident in the E7 countries, which are characterized by rapid economic growth and escalating energy demands, primarily met through the combustion of fossil fuels (Dong et al., 2020).

Moreover, the study's outcomes resonate with the literature that underscores the complex and multifaceted effects of financial inclusion on environmental quality. While some studies posit that financial inclusion can enhance environmental welfare by promoting efficient energy use and access to green technology (Renzhi & Baek, 2020), others highlight the potential adverse effects, particularly in the context of countries with high emission levels (Shah & Ali, 2023; Le et al., 2020). Lastly, while financial inclusion remains a pivotal strategy for achieving economic growth and reducing income inequality, its integration with environmental sustainability objectives is imperative. A balanced approach that aligns financial development with sustainable practices can ensure that the strides made in financial inclusion also contribute positively to the global efforts in combating environmental degradation and achieving the Sustainable Development Goals by 2030.

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POLICY SUGGESTIONS

Policymakers should focus on fostering a form of financial inclusion that emphasizes sustainability. Financial products and services should be designed to encourage investments in green technology and energy-efficient practices. Incentives for businesses and individuals to adopt eco-friendly practices can be integrated into the financial services framework. Countries, especially those experiencing rapid financial inclusion and economic growth, need to enforce stricter environmental regulations. This involves implementing policies that limit emissions and promote the use of renewable energy sources, thereby mitigating the environmental impact of increased financial activity. Financial institutions should collaborate with governments and international bodies to finance projects that focus on green technology and renewable energy sources. This can offset the negative impact of increased energy consumption and industrialization associated with financial growth. There is a need for widespread education and awareness programs to inform consumers and businesses about the environmental impact of their financial decisions. Promoting a culture of responsible consumption and investment can play a pivotal role in aligning financial inclusion with environmental sustainability goals. Continued research and monitoring are crucial to understand the evolving dynamics of financial inclusion and its environmental impact. This entails developing comprehensive datasets and employing robust econometric methods to analyze the relationship between financial inclusion and CO2 emissions across different contexts and over time.

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