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Analyzing the Environmental Impact of Financial Decentralization in Pakistan

Saba Aslam[1], Nadia Nazeer[2] & Sania Ahmad[3]

[1]*Department of Economics, The Women University Multan, Pakistan*
[2]*Lecturer Institute of Management Sciences, The Women University, Multan*
[3]*Lecturer Government College Women University Sialkot*

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Corresponding Author:
Sania Ahmad
Email:
sania.ahmad@gcwus.edu.pk

ABSTRACT

This study adds a new dimension to the body of research by analyzing the impact of fiscal decentralization (FD) on ecological footprints (EF) in Pakistan. In Pakistan, the author examined how financing dependency (FD) affects economic efficiency (EE) from 1990 to 2022, considering time series data with the variables of renewable energy consumption (REC), nonrenewable energy consumption (NREC), GDP and trade openness (TOP). Based on the obtained data, the Auto Regressive Distributed Lag (ARDL) model is chosen. To promote environmental sustainability, the regression analysis reveals that NREC, GDP, and TOP improve EF in Pakistan, while FD and REC reduce EF. This study suggests that Pakistan should optimize the integration of strategies that improve ecological quality by providing the lower level of government with access to environmentally aware technological advancements. These findings could be considered as a policy recommendation.

Introduction

The term "environment" refers to the whole of all factors, living and non-living, and how they interact with human life. Biological, or non-living, elements include things like air, water, earth, sunshine, and rocks. Animals, plants, forests, fisheries, and birds are all considered biological, or living elements. As part of broader governance changes, several low- and middle-income nations have decentralized financial and decision-making duties to lower levels of government. This process may give local governments increased authority to supervise the provision of health services and manage the funding for those services. (Kaushika et al., 2016).

The goal of decentralizing health functions, such as planning, budgeting, procurement, resource management, and health service delivery, is to increase accountability while simultaneously enhancing the effectiveness and quality of healthcare services. On the other hand, there exists conflicting data regarding the impact of decentralized financial and decision-making authority for health systems on general health outcomes such as reduced mortality and morbidity, as well as on concerns related to health care quality, efficiency, and equality. These inconsistent outcomes are primarily caused by variations in the types of health functions. (Bossert and Mitchell, 2010).

In the current state of the world economy, fiscal decentralization has taken on significant importance. Political leaders should consider making significant political and economic decisions for the benefit of economic goals through decentralization, or the transfer of responsibility to local authorities (Zahra et al., 2022). There are two possible ways to interpret the conflicting relationship between ecological protection and fiscal decentralization. Two models exist: the "Race to Bottom" theory and the other theory. Fiscal decentralization significantly impacts the degradation of the environment when businesses compete to save costs by providing workers with the worst working conditions or the lowest wages. They aim to stop a "race to the bottom" in which automakers relocate their facilities overseas and outsource work to non-union laborers. The environment's deterioration has long been a major global risk and a source of considerable concern. The increasing use of petroleum and coal contributes to environmental harm, increases global warming, and makes the earth warmer (Tiwari et al., 2023) Two of the most significant and controversial global issues now are environmental degradation and rising global temperatures (Yuan et al., 2022). There is growing agreement that these issues require immediate action. The increasing demand for natural resources by humans is placing significant stress on the natural world, leading to serious environmental issues. Only a few of these include extreme weather, degraded soil, pollution from the oceans, industrial emissions, wildlife extinction, and rising sea levels. The government has spent a significant amount of money trying to cut carbon emissions. systems for preserving and restoring the environment, such as enacting stringent environmental laws, significant ecological levies, special tax breaks, and favorable raising the cost of producing and using renewable energy, investing in the development of energy-efficient technology, and creating initiatives to increase people's awareness of the environment generally (Udeagha et al., 2022b)..

However, while the design aims to fortify the authority of local and provincial governments, foster economic growth, and improve public service delivery, it also elicits concerns about potential environmental harm. This issue statement aims to investigate and evaluate the environmental effects of Pakistan's decentralization of financial resources. Pakistan has implemented a financial decentralization process, leading to the transfer of administrative and budgetary responsibilities from the federal government to the national, provincial, and municipal governments.

This study aims to analyze how financial decentralization, uncertainty with monetary policy, and green innovation impact environmental sustainability. Contributing factors include globalization, financial decentralization, gross domestic product (GDP), and technological innovation. Concerning the governance implications, the authors suggested that China undertake a restorative approach to energy governance to foster an ‘energy efficient’ and emission-losing’ system while reclaiming the impaired the ecological integrity. Clearly, the pursuit of objectives aiming to reduce CO2 emissions and financially reduce the energy entails an accountability and governance framework that seeks to create bottom-up pressure to force the levels of government to reduce (control) the emissions of carbon (CO2) gas. This focus gives them the hope of moving up to higher levels within the local government.

The study presents the reviews of the available literature in section 2, followed by the theoretical and empirical framework in section 3. The fourth section presents the findings, followed by discussion and recommendations for policy.

Literature Review

Udeagha and Muchapondwa (2022), studied South African data from 1960 to 2020 to evaluate fiscal decentralization and environmental sustainability. Their findings noted economic globalization, economic uncertainty, and poor environmental performance to be negatively correlated and also highlighted fiscal decentralization and ecological efficiency to be correlated. Their findings suggest policymakers to encourage technological improvements to stimulate local and foreign investment. Zeng and Zhao (2023), analyzed the effects of financial decentralization on economic recovery during the years 2005 to 2019, focusing on the effects of financial decentralization and carbon emissions, suggesting that economic revitalization, when decentralized, impacts negatively the underprivileged, thus calls for extreme caution.

Cordelia Onyinyechi Omodero (2021), analyzed the role of fiscal decentralization and CO2 emissions control in Nigeria, from 2007 to 2020 and found that within less industrialized economies, of which Nigeria is one, the role of income fiscal decentralization affects the regulation of CO2 emissions, and the less the decentralization, the more the emissions. Faheem et al. (2023), discuss fiscal decentralization in the context of sustainability and from the Sustainable Development Goals lens discuss the paradox of fiscal decentralization for environmental sustainability whereby it can be potentially detrimental or beneficial for the state of the environment.

Nadeem et al. (2022) refer to a 2021 study, which stated that, in the context of Pakistan, the enhancement of environmental regulations can address the negative effect of fiscally decentralized structure on the local environment. In a similar context, Khan et al. (2023) conducted a study in France which focused on the relationships of the different means of renewables, government expenditure, natural resources, GDP and carbon emissions and found that, in the case of France, there is negative relationship between the means of GDP and government expenditure and the environment. Using the auto regressive distributed lag (ADRL) model, Mahmoud (2019) found relationships between GDP, trade liberalization and CO2 emissions, and concluded that in the case of Pakistan, though CO2 is inversely related to GDP, it is directly related to energy consumption.

Relatively recent works such as Aydin and Vardar (2022) pointed out a positive relationship of CO2 emissions with GDP and agricultural productivity, while negative impacts were observed with the case of fiscally decentralized structure. Ahmed et al. (2022) analyzed the case of fiscal decentralization in eight APCE countries and with the use of ARDL and dynamic methods he concluded that there is a notable effect of fiscal decentralization on the ecological footprints. Among others, Han et al. (2021) and Li et al. (2020) pointed out the complex energy consumption and fiscal relationship in the environment of China and Pakistan.

Other studies such as Nawaz et al. (2022) utilized time series data to analyze the effect of fiscal decentralization on Japan and found that negative CO2 emissions long-term vis-a-vis fiscal practices impacts were true. The analysis of the cross-national effect disparity strengthens the already complex narrative on the impact of fiscal decentralization and the environment.

The studies' results as a whole provide insights into the impact of fiscal decentralization and the extent to which it can drive environmental sustainability through the adoption of effective and efficient governance and the integration of renewables and sustainability, which improve

ecological circumstances and the environment, calling for more defined and deliberate policies. Additionally, there is a research deficit on the intersection of fiscal decentralization and energy consumption and its impact on ecological footprints, especially in developing economies, such as Pakistan, which propels the need for more research in the field and adaptive management to address the tension between economic development and environmental sustainability.

Theoretical Framework

Theories Related with Financial Decentralization

The goal of the project is to measure the asymmetric effects on carbon emissions of institutions, green technological innovation, and composite decentralization. To accomplish these aims, we constructed the following model using state-of-the-art theoretical techniques. To find plausible factors influencing CO2 emissions, earlier researchers used the IPAT model for their experimental work. The following equation presents this strategy, which is based on wealth, population, environmental costs, and technology. Whether I indicate the impact of carbon emissions and environmental pollution on the whole population (P), (A) denotes the degree of economic activity, and (T) denotes a technological level. This model was initially presented by Ehrlich and Holden in 1970 Dietz & Rosa81 expanded it to include a stochastic variant. The STIRPAT (Stochastic Impacts by Regression on Population, Affluence, and Technology) model is based on this concept. We have extended our model by adding additional variables like FD, INS, and HC in the following equation by utilizing the STIRPAT model specification. Our main goal is to create and implement a fiscal decentralization index and study how it affects CO2 emissions unequally at lower, middle, and higher quintiles. Increasing the usage of fossil fuels typically results in environmental pollution.

Data and Methodology

A variable description is given in the present section. These are variables that we have selected for our research work. We have chosen these variables according to their importance in the literature, their theoretical ground, and the obtainability of comparable data for all the countries under study. In the literature, there are many studies that have used these variables.

To present the designed model for the following equation:

$$ECF= \alpha0 + \alpha1FSDt + \alpha2GDPt + \alpha3TOPt + \alpha4RECt + \alpha5NRECt + \varepsilon$$

ECF= Ecological footprint

FSD= fiscal decentralizations

GDP= Gross domestic product

TOP= Trade openness

REC= Renewable energy consumption

NREC= Nonrenewable energy consumption

Whereas gross domestic product stands for gross domestic product, trade openness for trade openness, FSD for fiscal decentralization, and ECP for environmental, REC Consumption of renewable energy and nonrenewable energy consumption (NREC): ε denotes the error term, t indicates the time period. Model specification is the process of selecting which independent variables to include or exclude in a regression equation. Generally speaking, theoretical

considerations should have a greater influence on the regression model specification than methodological or empirical ones. Measuring the appropriate variables is essential to defining the right model. In fact, estimates for the variables you consider in the model may be biased if you leave out significant factors. We refer to this situation as omitted variable bias. Our model's primary objective is to examine how Pakistan's 2000 financial decentralization reforms influenced the environment and the scope of public service delivery. Thus, broadly speaking, the decentralization changes are the main independent variable in our research, whereas the size of services is the dependent variable. We examine the scope of services rendered during a 34-year period (1990–2022). To show if decentralization changes are present or absent, we employ a dummy variable. We use the fixed effects estimate approach to evaluate the impact of decentralization policies since we lack the explanatory variables that influence the size of service delivery.

Table 1: Data Description

Variable	Description	Data Source
ECP	Global hectares per capita	GFN
FDS	Revenue decentralization ratio of own of revenues to general government revenues	IMP
GDP	Constant 2010 us Dollars	WDI
TOP	Trade openness	WDI
REC	Renewable energy consumption	WDI
NREC	Nonrenewable energy consumption	WDI

Source: Own Elaboration

It is necessary to collect the data from an authentic source. Time series data will be collected from world development indicators (WDI), International Monetary Fund (IMF) and (GFN) and used the ARDL model from time period 1990-2022. Fiscal decentralization will be used as dependent variable and ecological footprint, gross domestic product, energy consumption, Nonrenewable energy consumption, Renewable energy consumption and trade openness will be used as independent variable. It is very important for achieving the goal of the study and provide the policy implication to choose and appropriates econometric technique.

Empirical analysis

The correlation matrix and descriptive analysis were part of the statistical study regarding the variable in question.

Quantitative analysis of the data set is accomplished through descriptive analysis. The period of interest for this study is 1990 to 2022.

Descriptive analysis of all variables used in the study is provided in Table 2.

Table 2: Descriptive Statistics

	ECF	FSD	GDP	NREC	REC	TOP
MEAN	0.778691	0.181509	1.89E+11	58.10929	50.42520	3177600
MEDIAN	0.773947	0.136276	1.73E+11	58.57436	50.24000	3236264
MAXIMUM	0.846183	1.060898	2.88E+11	62.47639	58.09000	38.49932
MINIMUM	0.730620	-0.079549	1.10E+11	52.30527	44.85000	21.45997
STD. DEV.	0.029563	0.237279	5.55E+10	2.817582	3.641713	4.905608

SKEWNESS	0.555339	2.380580	0.285565	-O.533225	0.526083	-0.669109
KURTOSIS	2.670005	9.08612	1.700423	2.424702	2.348785	2.475826
JARQUE-BERA	1.398442	62.12759	2.099053	1.529463	1.594929	2.151653
PROBABILITY	0.496972	0.000000	0.350103	O.4654459	0.450470	0.341016
SUM	19.46727	4.537715	4.72E+12	1452.732	1260.630	794.4000
SUM SQ. DEV.	0.020075	1.351234	7.40E+22	190.5304	318.2898	577.5597

Source: Own Elaboration

This table shows the ecological footprint has a mean value of 0.778691, median is 0.773947, maximum value is 0.866183, minimum value is 0.730620, standard deviation is 0.029563, probability value is 0.496972 positive skewed and has platykurtic because it's less then. Fiscal decentralization mean values is 0.181509, the median values is 0.136276, the maximum values is 1.060898, the minimum values is -0.079549, standard deviation value is 0.237279, probability value is 0.000000, positively skewed and has platykurtic because it's greater than 5. Gross domestic product mean value is 1.89,the median value is 1.73, the maximum value is 2.88, the minimum value is 1.10, and standard deviation value is 5.55, probability value is 0.350, Nonrenewable energy consumption mean value is 58.10929, median values is 58.57436, the maximum values is 62.47639, the minimum values is 52.30527, standard deviation value is 2.817582, probability value is 0.4654459, renewable energy consumption mean value is 50.42520, median values is 50.24000, the maximum values is 58.09000 , the minimum values is 44.85000, standard deviation value is 3.641713 , probability value is 0.450470, Trade openness mean value is 3177600, median values is 3236264, the maximum values is38.49932, the minimum values is 21.45997, standard deviation value is 4.905608, probability value is0.341016,

The table of correlation of all the variables of the study is called the correlation matrix. The correlation matrix shows that each variable in the matrix is correlation to other variables in the matrix it also tells the degree and direction of correlation among the set of two variable.

Table 3:

	ECF	**FSD**	**GDP**	**NREC**	**REC**	**TOP**
ECF	1					
FSD	0.121024	1				
GDP	0.292186	-0.2925111	1			
NREC	-0.208797	-0.1080289	0.85829176	1		
REC	-0.137731	0.19129055	-0.8939585	-0.9812014	1	
TOP	-0.041852	-0.4210383	-0.2852605	-0.4015112	0.34660905	1.000000

Source: Own Elaboration

The result shows that dependent variable ecological footprint has positive correlation with fiscal decentralization, gross domestic product and nonrenewable energy but it has negative correlation and linkage between trade openness and renewable energy with ecological footprint. Fiscal decentralization has negatively correlated with gross domestic product and trade openness but fiscal decentralization has positive correlation with nonrenewable energy, renewable energy and ecological footprint. Gross domestic product has positive correlation with trade openness but it has negative correlation with fiscal decentralization, nonrenewable energy and renewable energy. Renewable energy has positive correlation with fiscal decentralization and gross domestic product.

Renewable energy has positive correlation with fiscal decentralization and nonrenewable energy but it has negative correlation with gross domestic product and trade openness. Trade openness has positive correlation with gross domestic product but has negative correlation with fiscal decentralization, nonrenewable energy, and renewable energy.

Table 4: Unit Root Test Results.

	ADF		PP		
VARIABLES	Level	1st Difference	Level	1st Difference	Status
ECF	-3.32	-6.17	-3.02	-9.42	I (1)
FSD	-5.99	--------	--------	--------	I (0)
GDP	3.07	-4.85	3.22	4.80	I (1)
TOP	-4.84	--------	--------	--------	I (0)
REC	-4.28	--------	--------	--------	I (0)
NREC	1.87	-4.62	1.78	-3.18	I (1)

Source: Own Elaboration

The study started by checking level of integration of all variables in the time series data of Pakistan. Each analysis variable is studied during integration. To me not a single research variable is stationary (11). In the unit root tests for ADF and PP, ECF, GDP, NREC at first difference and FSD, TOP, REC is stationary at level. Unit root tests for all variables in time series data. For ECF, GDP, NREC is stationary at first difference having neither intercept nor trend. The time series data (ARDL) unit root tests show of dependent and independent variables in Pakistan under the study are mixture of first difference I (1) and level I (0).

Table 5: Bound test

T-Statistic	Value	Significance	I (0)	I (1)
F-STATISTIC	5.480314	10%	2.08	3
K	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

Source: Own Elaboration

The results of the bound test indicate that the F-statistic values are higher than the means of the upper and lower levels, suggesting a long-term association between the selecting factors. The present work employs the autoregressive distributed lag model. Results indicate that the long-term cointegration among ECF, FD, NREC, GDP, and TOP.REC is statistically significant at the 5% level.

Table 6: ARDL Long Run Result

Variable	Coefficient	Std. Error	T-Stats	Prob.
FSD	-3.68	1.49	-2.45	0.0027
NREC	5.36	2.99	1.79	0.0168
GDP	0.37	1.03	0.35	0.0785
TOP	0.42	0.05	8.40	0.0321
REC	-0.43	0.28	-1.54	0.4291
C	45.38	11.76	3.85	0.0078

Source: Own Elaboration

An increase in fiscal decentralization would result in an improvement of environmental quality by reducing the ecological footprint.The results are similar to the results presented by Tunio et al. (2021). Further the results indicated that one percent increase in gross domestic product (GDP) would result in a corresponding 0.37 percent increase in the ecological footprint coefficient. The negative impact on renewable energy usage is a 0.43 percent increase in the ecological footprint. Renewable energy usage has a significant impact on the ecological footprint, leading to a reduction in budgetary dependencies and an improvement in environmental conditions. The results indicate that there is a correlation between renewable energy consumption and more efficient energy allocation. Specifically, the t-statistics values show a negative drop of -1.54 percent in renewable energy consumption. Cheng et al. (2021) report similar results showing that RNE use improves environmental quality. This is also reported by Jiang et al. (2022) and Kirikkaleli et al. (2023) for Portugal. The results show that a unit increase in nonrenewable energy consumption will increase the ecological footprint by 5.36 units. Nonrenewable energy consumption drives high economic activity (GDP growth, trade openness, and fiscal decentralization) that impacts the environment. The results obtained in our study align with the discovery made by Abbasi et al. (2020). The findings suggest a link between nonrenewable energy consumptions and more efficient and effective energy use. Additionally, the t-statistics values show a positive 1.79 percent reduction in renewable energy consumption. Cheng and colleagues (2021).

Table 7: ARDL Short Run Result

Variable	Coefficient	Std. Error	T-Statistics	Probability
D(FSD)	-0.024232	0.013891	-1.744467	0.1150
D(FSD) (-1)	-0.060656	0.014692	-4.128446	0.0026
D(NREC)	0.020522	0.002911	7.050559	0.0001
D(NREC(-1)	0.008529	0.003104	2.748077	0.0225
D(GDP)	5.15E-12	8..60E-13	5.993524	0.0002
D(TOP)	0.004438	0.000897	3.200541	0.0108
D(TOP(-1)	-0.004438	0.001057	-4.198638	0.0023
COINTEQ(-1)	-0.3481	0.1294	-2.6903	0.0000

Source: Own Elaboration

According to short-term data, Pakistan's fiscal decentralization has major negative long-term effects. The findings are in line with those of Liu et al. (2022), Safi et al. (2022). For OECD economies, and Shahzad and Fareed (2023) for Canada. Remarkably, NREC has a long-term positive relationship with both TOP and EF in Pakistan. The findings are comparable to those of Yuan et al. (2022) and Jiang et al. (2022) for BRI nations. Remarkably, economic growth demonstrated a negligible positive correlation with TOP and ecological footprint for Pakistan's economy in the short term, while GDP demonstrated a large positive relationship with both over the long term. The outcomes are consistent with Chen et al. (2019). The short run and long run outcomes admitted converse consequence of REN on TOP torrential and ECF.

Conclusion and Policy Recommendations

This research explored the convergence of four variables GDP, FSD, NREC, RNE, and the ecological footprint and TOP of the Pakistani economy for the period of 1990-2022. This research uses the ARDL method to evaluate the effect of FSD on TOP discharge and the ecological

footprint. There exists a specific research work on the relationship of FSD, TOP emissions, and ECF. However, research of this nature is confined to the effects of FSD on TOP vis a vis panel and signal countries. This research also analyzes the effect of fiscal decentralization on the ecological footprint. This research incorporates RNE and NREC with past research, which for an extended time has been singularly focused on the Pakistani economy. The anticipated results suggested a long-term co-integration of the variables under study; moreover, the ARDL confirms a case of statistically significant negative relationship between fiscal decentralization and TOP and ECF for both the short and long run. The study results suggest that strict environmental regulations should be enacted by legislators to commence a "Race to the Top" among local authorities. It is suggested that fiscal decentralization could lead to an increase in foreign investment, an improvement in environmental quality, and a decrease in TOP. NREC has a negative relationship with TOP emissions which is of poor quality. However, the study results suggest that RNE does improve the environmental quality. The results are applicable to Kirikkaleli et al.2023.

Renewable energy is vital and government funding should be allocated to research and development in this field. Solar energy should be promoted more than traditional energy sources. With the rapid growth of Gross Domestic Product (GDP), environmentally damaging activities are promoted. Sustainably positive activities are economically environmentally damaging. Thus, the government will need to build an accountability structure to optimize energy conservation with the grants to be provided. The advancement of technology should be positively focused on the development of innovations and economically environmentally positive advancements that move the world from non-renewable energy to clean, renewable energy to positively target the world's overwhelmingly unsustainable practices. The modification of Pakistan's economic systems is required to foster innovation. The combination of different variables regarding the quality of the environment and the fiscal decentralization in Pakistan is what future research should focus on. There is an issue of using Pakistan as a test case. Further research on the situation of Pakistan is likely to focus on finding the optimal amount of foreign direct investment (FDI) that will facilitate economic growth. There is a problem in using Pakistan as a test case.

The current findings can be generalized to other countries for future studies. With less government intervention, Pakistan may improve ecological effectiveness. Therefore, to utilize fully the energy-saving opportunities, fiscal outlays must be accompanied by clear functional assignments to various tiers of government. Also, a greater improvement in technological innovation will help mitigate the negative impacts on the environment. Therefore, prioritizing the advanced, eco-friendly innovations that shift economic growth from nonrenewable to renewable, clean sources of energy, will be of greater importance. These eco-friendly innovations will have a positive impact on the environment and climate change. Pakistan also needs to change its economic structures to stimulate more innovation.

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