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Is the Banking Sector Equipped with the Capability to Address the Challenges posed by Climate Change in Pakistan?

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Abstract

This study attempts to examine the potential evolving role that the banking sector may be engaged in to diminish the consequences of climate change within the context of Pakistan. To check whether banks can facilitate and provide support to the country in its climate change mitigation strategies, carbon dioxide emissions (CO_2) have been used as a proxy to gauge the effect on climate change of two banking channels termed the *interest rate channel* and the *credit channel*. The study utilizes time series data spanning from 1990 to 2020 for Pakistan and employs Fully Modified Ordinary Least Squares (FMOLS) and Generalized Method of Moments (GMM) estimation techniques. The empirical results of this investigation affirm that the banking sector policies may have an impact on climate change, leading to lower carbon dioxide emissions through the interest rate channel and higher carbon emissions via the credit channel. In light of these empirical findings, the study advocates for a proactive role of commercial banks in contributing to the global shift from a high-carbon to a low-carbon economy through their lending criteria. Consequently, the study suggests the imposition of higher lending rates and reduced credit availability to mitigate the impacts of climate change.

Key words: Banking sector, green financing, lending rate, domestic credit, CO_2 emissions, climate change, environmental degradation, FMOLS, GMM

1. Introduction

The negative impacts of climate change are being unfolded in the form of rising temperatures and heatwaves leading to melting of glaciers with cloud and flood outbursts. Extreme weather conditions are a strong indicator of climate change and if urgent action is not taken today, there will be disastrous consequences, especially for developing countries like Pakistan that have several other pressing issues to deal with. Environmental agencies and governments acknowledge the challenge by incorporating climate action goals into development plans. Yet, current government efforts globally suggest attainment is distant, necessitating further actions. Relying solely on fiscal policy and

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government actions may insufficiently address the escalating environmental risks. Effective mitigation demands coordinated collaboration among various sectors—government bodies, central and commercial banks, environmental agencies, businesses, and individuals—to realize a low-carbon, sustainable future.

Empirical research has established several indicators of environmental degradation, of which, CO_2 emissions is the most widely used indicator of climate change. It is one of the most appropriate indicators and can gauge climate change accurately as around 76% of greenhouse gas emissions are made up of carbon dioxide emissions. CO_2 emissions are emitted through many ways, primarily as a result of anthropogenic activities which include economic growth (Shahbaz et al, 2013), energy consumption (Shobande, 2021; Broni et al. , 2020) , fossil fuel consumption (Chishti et al., 2021) remittances (Sharma et al., 2019; Qingquan et al., 2020), trade openness (Shahbaz et al., 2013; Pradeep, 2022), foreign direct investment (Pradeep, 2022) and urbanization (Liddle, 2013).

Over the last decade, communities and economies have made an effort to shift from fossil fuel to climate-friendly low-carbon energy usage and the financial sector has played a moderate role in this shift. While in developed countries green investments, green bonds and green financing are now a permissible and likely component of the monetary policy, this is still a notion that is relatively new for developing and low-income countries where the financial sector is not yet fully developed and therefore, they have not yet been able to identify and avail the financing opportunities that might be available to them to attract climate investments (Glemarec and Connelly, 2011).

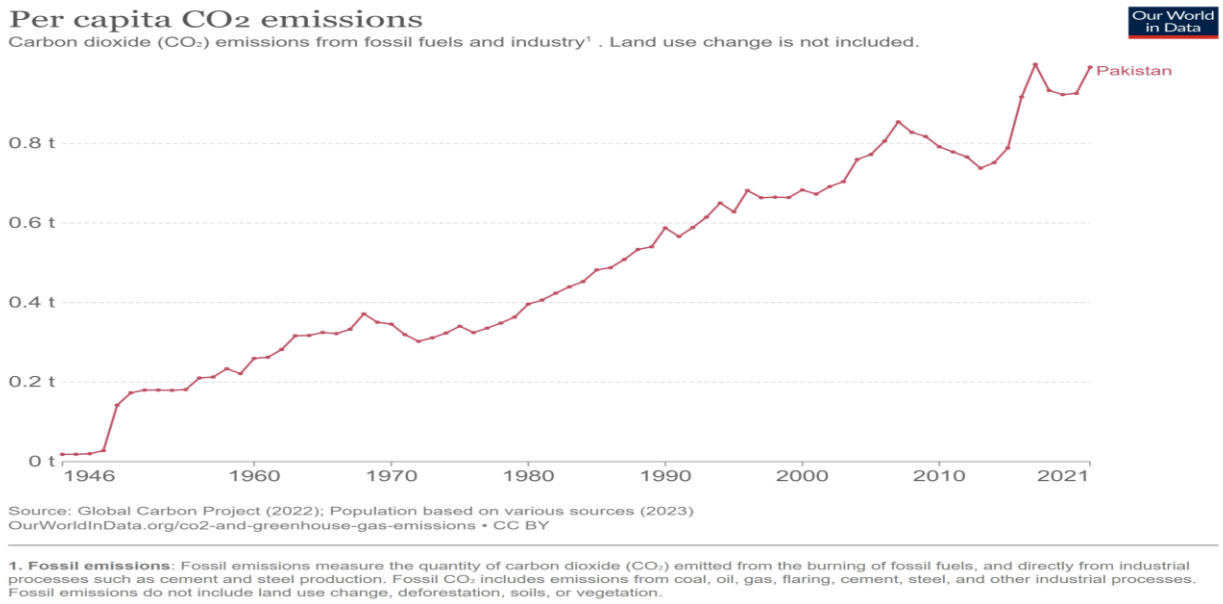
To bring green revolution, economic and social transformation will be required with huge investment. This is where central banks, commercial banks and other financial institutions can function by allocating funds and resources towards eco-friendly and energy-efficient assignments that would support the switchover to a low-carbon economy.

The literature on environmental economics is extensive and has highlighted various dimensions of environmental issues and their possible triggers and responses. Several studies have also been conducted to explore the influence of monetary policy on climate

change, specifically carbon emissions. However, most of these studies have focused on developed countries. Very limited studies are available that justify the implication of commercial banks environmental role for developing and low middle income economies. In order to address this gap in literature and study the impact of monetary policy on carbon emissions in the developing world, this research is being conducted. The results of this study may provide the pathway for further studies on the topic with a focus on developing countries. Secondly, bulk of the studies have employed panel data for the analysis. This study employs time series data for the analysis and explain the results of the study in the context of the economic conditions of a single country.

With the growing threat of climate change that poses a risk to the people and economy of Pakistan, like the deadly floods of 2022 that caused havoc throughout Pakistan with millions of people displaced, and billions of dollars damage, timely action must be undertaken by different sectors of the economy now before it gets too late. Figure 1 below shows the rising levels of per capita CO_2 emissions in Pakistan.

Figure 1: Per Capita CO2 emissions



Note: This figure shows per capita CO_2 emissions for Pakistan from 1946 to 2022. From *Pakistan: CO_2 Country Profile* by Hannah Ritchie, Max Roser and Pablo Rosado (2020). Adapted from https://ourworldindata.org/co2/country/pakistan

A dip can be observed in 2021 due to Covid-19. However, the rising trend of the emissions has been observable over the past few decades.

The contribution of banking sector in times of climate emergency, is an aspect that a country like Pakistan can benefit from. The banking sector of Pakistan is still growing and whether it can have a significant impact on environmental emissions and support environmentalists and the government of Pakistan in their effort to reduce the shocks of a changing climate needs to be evaluated and assessed.

The objective of this study is to investigate whether the banking sector that is the main provider of credit and lending in the economy can support or hinder the achievement of a sustainable economy that is carbon resilient in Pakistan. For this purpose, time series data from 1990 – 2020 has been selected for the study. FMOLS and GMM estimation models are applied to the data for this analysis.

This study will furnish to the literature a study that outlines the involvement of the banking sector, essentially for low and middle income countries, to lessen climate change effects and damages.

The study is ordered as follows. Section 2 presents a review of literature on the topic. Section 3 discusses the methodology and estimation techniques employed for the analysis. Section 4 outlines the data and data source. Section 5 states results and discussion of the analysis. Section 6 discusses policy recommendations and conclusion of the study.

2. Literature Review

Calls have been made for central banks to assist in the switchover to a low-carbon economy. Given the autonomy that central banks have, it is possible to establish monetary mechanisms that effectively curb greenhouse gas emissions and monetary policy tools may play a proactive and pivotal role in achieving this objective.

Volz (2017) studied the role central banks can play in the convergence towards green financing. By investing and allocating resources towards sustainable projects and having environmental objectives, monetary policy may bring a radical change. The incorporation

of sustainability into their goals may prove congruent in achieving price stability. The first justification for the role of central banks in addressing the environmental challenge is to counter the risks faced by the overall economy and the financial industry. Second is the rectification of credit market failure on the part of banks that have been providing credit and finance facilities over decades to businesses that have been intensively contributing to environmental emissions. The third justification would be that with the credibility that central banks have, they can act as a powerful agent to integrate environmental stability into their objectives and policy framework.

Employing a stylized AD-AS model, Attilio et al. (2023) study found that contractionary monetary policy leads to lower domestic emissions both in the short-run and the long-run for four regions of US, UK, Japan and the Eurozone. Moreover using a Global Vector AutoRegressive (GVAR) model, their study does not find evidence of cross-region effects of monetary policy.

In their study on the interaction between monetary policy and carbon neutrality, Dottling and Lam (2023) argue that the stock prices of high-emission firms are more sensitive to monetary policy shocks and with tightening monetary policy, though a decline in investment is observed, there is no decline in emissions intensity and the growth of emissions in high-emission firms surpasses that of low-emission firms in the long-run as firms' investment in low-carbon technologies abates.

Dikau and Volz (2023) reviewed a specific monetary policy instrument known as 'window guidance' to promote sustainable lending and investment by the People's Bank of China (PBC) and the China Banking Regulatory Commission (CBRC). This instrument was an informal policy instrument to urge financial institutions to lend credit facilities towards sustainable projects. According to the authors, the introduction of window guidance could be the first step for capital to be reallocated towards green activities.

According to Monnin and Barkawi (2015) the targeted use of refinancing lines have a great future prospect for providing a solution to Bangladesh's environmental goals, provided these loans are granted for long-term as the transition from carbon-intensive to

low-carbon projects cannot happen immediately and can only be met in the long run with long-term funding and maturity.

Using VAR/VEC models, Shobande (2021) studied the structure through which monetary policy may impact carbon emissions in East African economies using time series. Results of the study revealed that the credit channel uni-directionally causes carbon emissions whereas the interest rate channel bi-directionally causes carbon emissions. Accordingly, the author concluded that failure to engage central banks to put to use the monetary mechanism for financing the environment could result in increased levels of carbon emissions.

According to a study by Chishti et al. (2021), an increase in borrowing rates as a result of contractionary monetary policy does not work in favor of both producers and consumers as both do not wish to get loans from commercial banks with higher interest payments. The results of their study establish a long-run association between expansionary monetary policy and carbon dioxide emissions (CO_2). Another result of their study is the increase in CO_2 as a result of increased aggregate domestic consumption spending per capita. The authors are of the view that by promoting green technologies, monetary policy can effectively, reduce the level of CO_2.

Broni et al. (2020) conducted a study to explain the lending rate and carbon emissions nexus in the USA. The result of their study showed that though the lending rate granger causes pollution, its negative or positive impact depends on the economic and sociopolitical circumstances of the US.

Accordingly, during economic stability and sound political conditions, lending rates led to a decrease in carbon emissions but during regimes that were marked with instability and crisis, lending rates led to an increase in carbon emissions.

The role of monetary policy and the banking sector in mitigating environmental emissions has been gaining attention. Pakistan is a developing country that is facing serious climate-related challenges and the floods of 2022 in Pakistan present a climate catastrophe. Immediate and scrupulous action needs to be taken to respond to this

pressing issue. In addition to the involvement and strategies of the government and environmental agencies, it is important to investigate in detail the channel of monetary transmission for climate change in Pakistan and provide useful insights for climate policy.

3. Methodology and Estimation Techniques

Carbon dioxide (CO_2) emission is the main dependent variable in this study and is an indicator of climate or environmental degradation. We endeavor to examine how carbon emissions may be influenced by the banking sector.

Monetary policy impacts the economy mainly through the interest rate, exchange rate, credit, asset prices, and expectations channels, significantly influencing aggregate demand, output, and the overall economy. In this study, two monetary mechanisms or channels, the interest rate channel and credit channel, are to be explored which may affect CO_2 emissions by changing aggregate demand in the economy. The first mechanism considers lending rate as the proxy variable for the monetary channel. The second mechanism being explored in the study is credit and loans extended by commercial banks to businesses and individuals.

Therefore, the two main independent variables that present monetary mechanism and are transmitted to the economy via the banking sector are:

i. Lending rate (proxy variable for interest rate channel)
ii. Domestic credit to GDP ratio (proxy variable for credit channel)

Expansionary monetary policy, by lowering interest rates, influences the lending rates that are determined in the interbank market. Consequently, reduced lending rates are offered by commercial banks that encourage consumers and producers to increase lending and stimulate the economy. As a result, higher consumption spending and higher production levels are observed in the economy which is translated into greater environmental emissions (Qingquan, 2020). Contractionary monetary policy works oppositely. Several studies have been conducted to check the impact interest rates might have on environmental emissions, specifically carbon emissions. While Eyraud et al.

(2011), Pradeep (2022) and Broni et al. (2020) report a detrimental impact, studies by Chishti et al. (2021) and Qingquan et al. (2020) have reported a favorable impact of interest rates on climate change via carbon emissions proxy. With mixed results being reported, interest rates are expected to have different results for different countries.

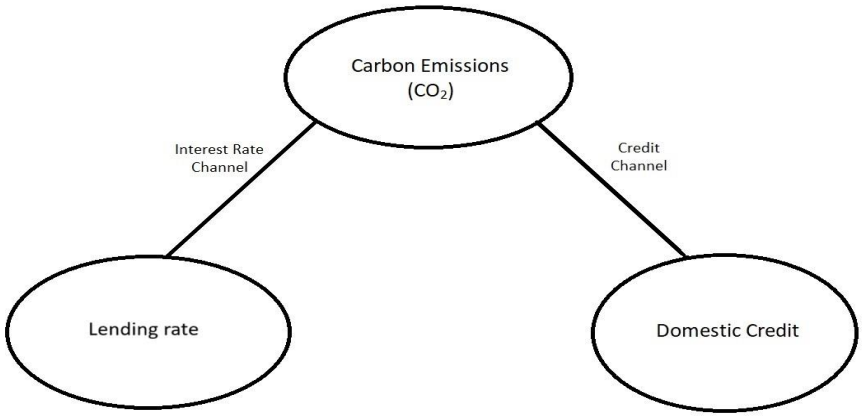
The second monetary mechanism employed in the study is the credit channel and the main tool for the credit channel indicates the domestic credit that is provided to the private and public sector by banks and other financial corporations in the country. Some studies have related domestic credit to the financial development of a country. Shehbaz et al. (2013) and Lee et al. (2015) have reported a negative impact of financial development on environmental emissions. Accordingly, when the financial sector of a country is developed, strong and mature, it serves as a channel for investment into environment-friendly projects (Birdsall and Wheeler, 1993; Frankel and Rose, 2002). On the contrary, studies by Tamazian and Rao (2010), and Ayeche et al. (2016) have reported a positive impact of domestic credit on carbon emissions via growth channels. Similarly study by Komal and Abbas (2015) has shown that financial development significantly affects energy consumption via the economic growth channel which ultimately leads to higher environmental emissions.

The following two models are the base models for our analysis where Model 1 uses Lending Rate (LR) and Model 2 uses domestic credit to GDP ratio (CR) as the monetary proxy variable.

$$CO_2 = \beta_o + \beta_1 LR \qquad \text{Model 1}$$

$$CO_2 = \beta_o + \beta_1 CR \qquad \text{Model 2}$$

Figure 2: Carbon emissions and banking sector transmission channels



To address any specification bias, other control variables included in the model are gross domestic product per capita, urban population, trade openness and energy consumption.

GDP represents economic activity in our study. Since economic activity is tied to industrial development which in itself leads to greater environmental emissions, the assumption here is that GDP leads to an increase in carbon emissions. According to the Environmental Kuznet Curve (EKC) hypothesis proposed by Grossman and Krueger (2005), in the preliminary phase of economic growth, pollution increases but after it has reached a certain level, pollution starts decreasing with the further increase in economic growth. As an economy grows, environmental quality is expected to improve with a focus towards eco-friendly investments and projects. Studies focusing on the EKC hypothesis have shown mixed results for developing countries (Khan et al., 2020). We expect GDP to positively impact CO_2 emissions in case of Pakistan.

Including urban population in the model is relevant as with the massive influx migration of people in the last three to four decades from rural to urban areas in search of work, an increase in energy demand and consequently, CO_2 have been observed. With different levels of economic development, the influence of urbanization on environmental emissions varies according to a study by Lin and Li (2015). To gauge the impact of

urbanization, urban population is introduced as a control variable in the model which is expected to have a positive sign in case of Pakistan.

Energy consumption is considered to be one of the major drivers of environmental deterioration and carbon emission is one of the direct consequences of energy production. Air pollution, water pollution, and ultimately climate change are the after-effects of energy production and energy consumption. Chishti et al. (2021), Bhuiyan et al. (2018), Zaman and Moemen (2017) and Khattak et al. (2020) have investigated energy and CO_2 link and have found the harmful impact of energy combustion on the environment owing to the augmented levels of carbon emissions. Energy consumption data in this study refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport. The expected sign of energy consumption in our analysis for Pakistan is positive.

Trade openness may have a positive or negative impact depending on which portion of the EKC the country lies on. Suri and Chapman (1998) explain that as imports of manufactured goods by industrialized countries increase, their energy requirements fall which leads to a reduction in environmental emissions and contributes to the downward slope of the EKC. Alternatively, an increase in exports of manufactured goods by industrialized countries leads to increased energy requirements and consequently higher emissions. This contributes to the ascending slope of the EKC. Hence, trade is included in the model as a control variable to see the impact it may have on carbon emissions.

The general model after including the control variables is as follows:

$$CO_2 = f(LR, GDP,\ UR, EN, TR) \quad (1)$$

The functional form of the models are:

$$CO_{2t} = \beta_{0t} + \beta_{1t} LR_t + \beta_{2t}\, GDP_t + \beta_{3t} UR_t + \beta_{4t} EN_t + \beta_{5t} TR_t \quad (2)$$

$$CO_{2t} = \beta_{0t} + \beta_{1t} CR_t + \beta_{2t}\, GDP_t + \beta_{3t} URt + \beta_{4t} EN_t + \beta_{5t} TR_t \quad (3)$$

The logarithmic version of the models are as follows:

$$lnCO_{2t} = \beta_{0t} + \beta_{1t}\, LR_t + \beta_{2t}\, lnGDP_t + \beta_{3t}\, lnUR_t + \beta_{4t}\, lnEN_t + \beta_{5t}\, lnTR_t \quad (4)$$

$$lnCO_{2t} = \beta_{0t} + \beta_{1t}\, lnCR_t + \beta_{2t}\, lnGDP_t + \beta_{3t}\, lnUR_t + \beta_{4t}\, lnEN_t + \beta_{5t}\, lnTR_t \quad (5)$$

Two estimation techniques are applied to check the influence of the financial instruments on environmental emissions.

- Fully Modified Ordinary Least Square (FMOLS)
- Generalized Method of Moments (GMM)

FMOLS estimation is employed to evaluate the long-run impact of the independent variables on the outcome variable as Johansen co-integration test confirms the presence of con-integrating link and a long-run association of the variables in our data. Co-integrating links between time series data and non-stationarity of data lead to endogeneity in the regressors. Ordinary Least Square (OLS) regression does not take into account long-run endogeneity in the regressors, and the presence of such endogeneity produces bias (Phillips, 1995). That is why we have selected FM OLS estimation for this study as it modifies OLS result to account for endogeneity. FMOLS estimation is preferred over OLS as it gives reliable parameter estimates even when the sample size is small and also checks for robustness (Bashier and Siam, 2014).

GMM is the second estimation technique applied with both internal and external instruments. Lagged values of control variables have been used in the GMM model as internal instruments. Two external instrumental variables that have been selected by checking their validity are saving (as a ratio of GDP) and debt (as a ratio of GDP). F statistics is used to check the relevance of the instruments chosen and Hansen's J Chi square test is used to check the exogeneity of the instruments. Both instrumental variables chosen in the model are found to be relevant and exogenous.

4. Data and Variables Description

The study includes data from 1990 – 2020 for carbon dioxide emissions as the dependent variable, lending rate and domestic credit as focused variables and a set of controlled variables. A detailed description of the data and its source is given in Table 1.

Table 1: Data description and data source

Sr. No	Variables	Abbreviation	Description / Unit	Detail	Source
1	Carbon Emissions	CO_2	Carbon dioxide emissions (metric tons per capita)	Carbon dioxide generated when fossil fuels are burnt and during cement manufacturing	World Development Index
2	Lending Rate	LR	Lending Rate (%)	Weighted average lending rate calculated by weighting interest rates by corresponding amounts of loans.	Economic Survey of Pakistan
3	Domestic Credit	CR	Domestic credit (% of GDP)	Domestic credit pertains to financial resources like credit, loans, liquid assets offered to the public and private sector by banks and other financial entities in the country such as investment and leasing companies, capital markets, money lenders and insurance companies	Economic Survey of Pakistan
4	Economic Activity	GDP	GDP per capita (constant 2015 US$)	GDP per capita is gross domestic product divided by midyear total population of the country.	World Development Index
5	Urbanization	UR	Urban population (% of total population)	Individuals living in urban areas of the country.	World Development Index
6	Trade Openness	TR	Trade (% of GDP)	Aggregate value of exports and imports of goods and services.	World Development Index
7	Energy Consumption	EN	Energy use (kg of oil usage per capita)	Consumption of primary energy before being processed and converted for consumption by end-users	World Development Index

5. Empirical Results and Discussion

This section presents the empirical results of the study. Preliminary checks were made for time-series data before estimation. Since time-series data often exhibits serial correlation, HAC Newey-West standard errors are estimated for regression models. Multicollinearity was checked for both estimation models using the Variance Inflation Factor (VIF) Test. As a rule of thumb, a VIF value of 10 or greater than 10 indicates problem of multicollinearity. VIF value was observed to be less than 5 for all models. Hence, the data does not suffer from the problem of multicollinearity.

5.1 Unit Root test – Augmented Dickey Fuller Test

We start the estimation process by first running the unit root test with results presented in Table 2 below:

Table 2: Summary of Unit Root Test – Augmented Dickey Fuller (ADF)

Variable	ADF Test statistics		Order of integration
	Level	First difference	
CO2	-1.9462	-3.5136**	I (1)
	(0.3080)	(0.0170)	
Lending Rate	-3.8622	-9.4916***	I (1)
	(0.1430)	0	
Domestic Credit	-1.3048	-4.2140***	I (1)
	(0.6140)	(0.0030)	
GDP per capita	-0.5912	-3.1483**	I (1)
	(0.8580)	(0.0340)	
Urban Population	1.5719	-2.7609*	I (1)
	(0.9991)	(0.0768)	
Energy Consumption	-2.3677	-3.7852***	I (1)
	(0.1590)	(0.0080)	
Trade Openness	-1.7288	-5.3735***	I (1)
	(0.4070)	0	

Note: t-statistics significant at 1% , 5% and 10% level of significance are given by ***, ** and * respectively

Probabilities in parentheses.

The results of the Augmented Dickey-Fuller (ADF) test show that all variables in the model are stationary at first difference. This indicates that all variables are integrated of order 1 I(1).

5.2 Johansen Co-integration Test

Johansen Co-integration test is run to identify whether the non-stationary time series in our study has a long-run equilibrium. For both equations 4 and 5, Trace statistics and Eigenvalue statistics indicate that a long-run relationship exists in the model with the null hypothesis of no co-integrating equation being rejected at 5% level. Since both models are observed to have co-integrating equations, the FMOLS estimation technique has been selected for the study and GMM estimation is employed to cross-check the results.

5.3 Results

Estimation results are given in Table 3:

Table 3: Estimation Results

	FMOLS		GMM	
Variables	**Column 1**	**Column 2**	**Column 3**	**Column 4**
	Model 1	**Model 2**	**Model 1**	**Model 2**
Lending rate	-0.0387*		-0.0119*	
	(0.0021)		(0.0072)	
Domestic Credit		0.2083**		0.2297***
		(0.0578)		(0.0579)
GDP per capita	1.1069***	0.8389***	1.5061*	0.7313***
	(0.2522)	(0.1916)	(0.7715)	(0.2592)
Urbanization	1.4751*	1.0883*	2.4932	0.7125
	(0.7618)	(0.5697)	(2.4094)	(0.7660)
Energy Consumption	1.1743***	1.5305***	1.3442**	1.5088***
	(0.1905)	(0.1857)	(0.3967)	(0.1877)
Trade Openness	-0.1333**	-0.2277***	-0.0088	-0.2159**
	(0.0863)	(0.0658)	(0.2092)	(0.0989)
Constant	-9.6458***	-11.7220***	-10.4277***	-12.2736***
	(1.1391)	(1.1341)	(2.3482)	(1.3599)
R-squared	0.9291	0.9421	0.8628	0.9414
J-Statistics			1.2683	1.4831
Prob			(0.2729)	(0.2011)

Note: Standard error in parentheses
****, ** and * denote significance level at 1%, 5% and 10% respectively*

The results for model 1 are reported in column 1 and column 3 where the proxy for the monetary mechanism is lending rate. The results show that lending rate has a significant negative effect on carbon emissions. With a unit percentage increase in lending rate, CO_2 emissions decrease by 0.0387% and 0.0119% for FMOLS and GMM estimations respectively.

The results of model 2 are presented in column 2 and column 4 where the proxy for monetary mechanism is domestic credit. The results indicate a highly significant positive impact of domestic credit on carbon emissions. The parameter estimate shows that a unit

percentage increase in domestic credit leads to a 0.2083% and 0.2297% increase in carbon emissions using FMOLS and GMM estimation techniques respectively.

Discussion

The parameter estimates from both FMOLS and GMM estimations show that the lending rate has a significant negative effect on CO_2. The results are analogous to former studies by Chishti et al. (2021) and Qingquan et al. (2020) that have estimated a negative impact of interest rate on carbon emissions. CO_2 emissions are generated by various channels where consumption and production activities are most profound and the pattern of both channels will help interpret and justify the results of this study. Higher lending rates deter consumers from borrowing from commercial banks. The investment level remains low and savings remain high in times of high or increasing lending rates. Opportunities and financial capability of consumers to invest in purchases, including carbon-emitting activities, remain low too as it is only a small percentage of financially stable and affluent consumers who can still afford to borrow at high lending rates. Commercial banks' portfolios and their credit criteria shifts from the least affluent customers to the wealthy ones as the credit score of customers changes.

From the production point of view, the additional cost from higher lending rates augments pressure on producers and manufacturing firms especially the ones that tend to adopt cost-cutting measures. These measures would include using inputs and raw materials that are cheaper but potentially harmful to the environment (Broni et al. 2020). Instead of opting for high-cost environmentally friendly products, even consumers would opt for buying low-cost products.

We observe a positive impact of domestic credit on carbon emissions which can be explained via the economic development channel. As borrowing and lending increases in the economy, economic growth is promoted. However, given that this investment is channeled towards technology that is innovative but not environmentally sustainable, an increase in economic growth coupled with soaring levels of carbon emissions is expected. In low-middle income countries, growth and development entail replacement of old

equipment with new one which may be technologically efficient, but not environmentally (Grossman, 1995). As Grossman (1995) points out that in low and middle-income countries, growth is resource-using in its initial stages and private agents do not see much benefit from conservation and sustainability.

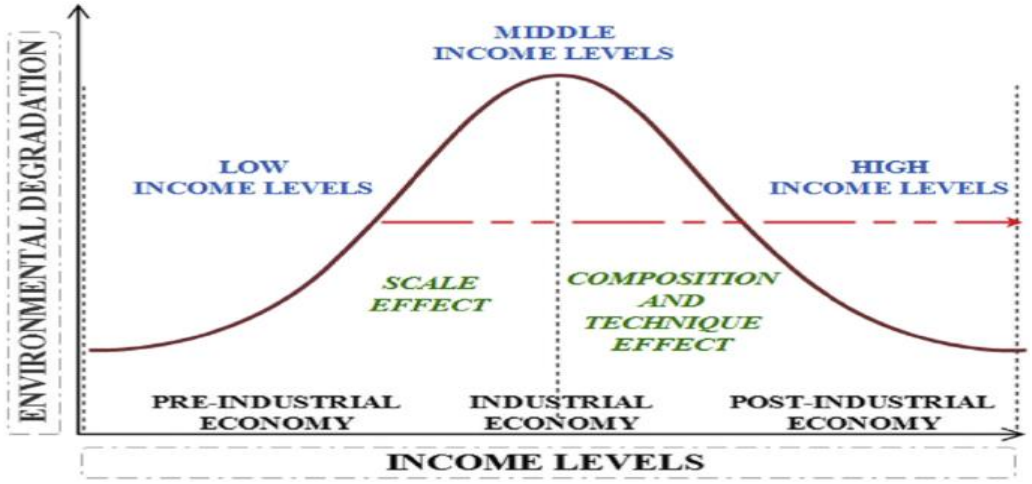
The positive impact can be attributed to scale effect dominating the technique effect. In an economy where the technique effect dominates, an increased level of economic activity would encourage efficient allocation of resources and usage of better and more efficient techniques of production that would reduce CO_2 emissions (Grossman and Krueger, 1991). On the contrary, if the scale effect dominates, economic growth would lead to surging levels of CO_2 emissions. The net result depends on which effect is stronger. Pakistan lies on the rising portion of the EKC (Nizamani et al., 2023) where the scale effect dominates and greater economic activity is accompanied by greater use of energy which is why higher levels of CO_2 emissions are observed as a result of higher levels of domestic credit. This result is consistent with Tamazian and Rao (2010), and Ayeche et al. (2016) that have reported a positive impact of domestic credit on carbon emissions via growth channel.

In the context of Pakistan, domestic credit provided to the private sector seems to play an important role in carbon emissions. Providing loans, funds and trade credits to private corporations that are high carbon emitters means they have access to funds that they can use to expand production facilities and plants but at the same time, contribute more towards environmental damage in the form of higher levels of CO_2 emissions. With higher available credit, individuals tend to increase spending on consumer goods that emanate greater use of fuel and electricity and higher levels of emissions. Soaring CO_2 concentrations due to higher consumption will ultimately be observed.

Our empirical findings confirm that a cut in lending rate and greater credit accessibility leads to an increase in CO_2 emissions as the readily accessible credit provision by the banking sector leads to an increased demand for consumer financing products like automobiles, new appliances, home loans and margin loans.

Likewise, a positive impact of GDP per capita on CO_2 emissions has been established in this study through both FMOLS and GMM estimation. In the context of Pakistan, it is inferred that Pakistan lies on the upward-sloping part of the EKC as depicted by the slope for low income levels in figure 3, where an increase in income and earnings intensifies the pollution level. Since no consistent effort has been put into sustainable production activities in Pakistan, and producers do not take sustainability and environmental impact into consideration, increased industrial activity along with economic growth has contributed to increased levels of CO_2 emissions.

Figure 3: Environmental Kuznet Curve



Note: This figure shows the Environmental Kuznet Curve. From "Empirical study of the Environmental Kuznets curve and Environmental Sustainability curve hypothesis for Australia, China, Ghana and USA," by Samuel A. Sarkodie and Vladimir Strezov, 2018, *Journal of Cleaner Production, 201*, p. 98-110

The results for urbanization are positive but insignificant for GMM estimation. Therefore, urbanization may not be a very significant variable that leads to environmental disruption or degradation in the case of Pakistan.

Significant positive results are observed via both channels for energy consumption. CO_2 emissions are one of the direct consequences of energy production as well as energy consumption. The harmful impact of energy combustion appears in the form of

environmental deterioration via a considerable increase in carbon emissions. Energy consumption affects CO_2 emissions through the growth channel as well where higher economic growth drives increased energy demand.

Trade shows a negative and statistically significant impact on CO_2 emissions through both interest rates and credit channels. The negative impact can be construed to a soaring trade deficit in Pakistan. According to Dinda and Coondoo (2006), the impact of trade on greenhouse gas emissions depends on the characteristics and comparative advantage a nation has in terms of its trade. With rising imports, Pakistan has seen an increasing trade deficit in the last two decades. With increasing imports of petroleum and petroleum products, and mineral fuels comprising the greatest percentage of Pakistan's imports, it can be inferred that the effect of trade openness on carbon emissions is negative.

6. Conclusion and Policy Recommendations

This study investigates the impact of the banking sector on climate change in Pakistan. Carbon emissions have been used as a proxy for climate change while two banking transmission channels, termed interest rate and credit channel, have been selected for the study. Time series data from 1990 to 2020 for Pakistan has been used and FMOLS and GMM estimation techniques have been applied in the study. Our findings confirm a negative significant impact on carbon emissions through the interest rate channel and a positive significant impact through the credit channel in the case of Pakistan. Higher lending rates would deter consumption and production activities that contribute to higher energy consumption, economic growth and environmental emissions. In the context of Pakistan, the interest rate channel can serve to provide a vital contribution towards mitigation of carbon emissions. The results of the credit channel mechanism of this study imply a financial sector of Pakistan that is not yet fully developed and hence, a rise in the domestic credit to the public and private sector deteriorates the environment as additional investment is made toward irresponsible consumption and production activities that are accompanied by inefficient resource usage rather than environmentally efficient projects. Ultimately, levels of carbon emissions escalate. Our results highlight the capability of the banking sector to address climate change. The implication of the observed relationships is that credit and lending by banks should be reduced to combat climate change in Pakistan.

The result of this study suggests further research where the implication of greater credit and lending aimed toward projects that utilize green energy resources may be studied and explored. This research study gives the direction and path for further research to identify the exact scope and tools that the banking sector in developing countries may consider to effectively take action to combat climate change.

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