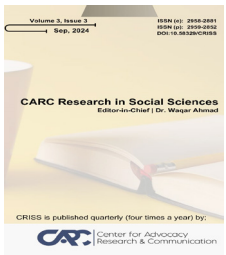
15-52-CRISS-631-169

CARC Research in Social Sciences 3(3) (2024) 435-444

Content list available at:
https://journals.carc.com.pk/index.php/CRISS/issue/view/10

CARC Research in Social Sciences

Journal homepage : journals.carc.com.pk



Assessing the Impact of Market Supporting Institutions on Environmental Outcomes: Empirical Evidence from Pakistan

Dr. Said Zamin Shah* & Dure Nayab

Department of Economics, Faculty of Social and Basic Sciences, Islamia College Peshawar, Khyber Pakhtunkhwa, Pakistan

ARTICLE INFO

Article history:

Received: June 06, 2024
Revised: September 12, 2024
Accepted: September 14, 2024
Published: September 30, 2024

Keywords:

Market supporting institutions
environmental outcomes
ARDL
Pakistan

ABSTRACT

There is a considerable debate on the impact of institutional quality including economic and political institutions on economic outcomes. Most of the existing discourse has focused only on their economic implications. This study, on the other hand, seeks to explore the role of market supporting institutions, measured by economic freedom, on environmental outcomes in Pakistan. While utilizing data for the period 2000–2020 and using ARDL bounds testing approach, we arrive at few important conclusions. The empirical results indicate that market supporting institutions such as economic freedom have strong negative impact on environmental degradation (measured by CO2 emissions per capita and CO2 emissions from electricity and heat production) in Pakistan. Importantly, the effect holds both in short-run as well as in the long-run, suggesting that the strength of market supporting institutions not only lowers environmental pollution in the country but it also mitigates the environmental degradation from electricity and heat production. The estimated results are robust through alternative estimation strategies. Ultimately, the study implies that the strength of market supporting institutions can be an eventual boon to the environmental outcomes of Pakistan's economy.

INTRODUCTION

Market supporting institutions (MSIs) lay the foundations for greater economic opportunities, better standards of living and flourishing businesses and economy. Moreover, they play the vital role in boosting the economic and political prosperity as they also limit the extent of environmental emissions in the country. Economic freedom (EF) is the most crucial factor of the free market economy. It consists of four pillars that includes the rule of law, government size, efficient regulation, and market openness. Whereas market supporting institutions are the institutions and policies that advocates EF. The basic and crucial components of market supporting institutions include personal choice, voluntary exchange, freedom to compete in markets, and protection of personal and property rights. Additionally, market supporting institutions includes regulations, reinforcement of these regulations and organizations that support market transactions. They create incentives for people to participate in the market by efficient transmission of information, ensures fair competition, provides freedom to make contracts with any party of preference of the person, as well as ensures private property rights and rule of law. On the other hand, it necessitates restraining the government from seizing private property and interference with personal free choice.

Governments weaken the EF by replacing taxes, spendings by government, and regulations for free choice, voluntary exchange, and market coordination. The success of a market economy is contingent on the existence of a set of institutions that support the functioning of private

*Corresponding author:
Dr. Said Zamin Shah | Department of Economics, Faculty of Social and Basic Sciences, Islamia College Peshawar, Khyber Pakhtunkhwa, Pakistan
e-mail: szshah@icp.edu.pk

How to Cite:

Shah, S. Z., & Nayab, D. (2024). Assessing the Impact of Market Supporting on Environmental Outcomes: Empirical Evidence from Pakistan. *CARC Research in Social Sciences, 3*(3), 435–444.

DOI: https://doi.org/10.58329/criss.v3i3.169

property and market forces in generating wealth-creating incentives. Ultimately, a legal framework aims at reducing the efficiency costs of externalities, and a constitution that restrains the powers of the state, can all boost private incentives to generate wealth. In a similar vein, a sound tax system is needed to generate adequate revenue without undermining private incentives through high tax rates or arbitrary policy shifts.

Economic expansion is frequently credited with improving environmental conditions because of the positive feedback loop it creates, as described by the Environmental Kuznets Curve. Countries that are economically robust are not always geographically vast or endowed with abundant natural resources. By increasing their economic dynamism and integration into global markets, many countries have been able to expand opportunities for their populations. Focusing on measures that increase EF is the actual approach to ensure environmental, social, and governance refinement. The connexion between economic freedom, personal freedom, and development across the world is unmistakable, as proven by the Index of EF. EF has been found to boost the potential for environmentally friendly innovations and technologies in countries all over the world. The positive relationship between economic freedom and higher levels of innovation offers increased ability to deal with environmental threats, as well as the major improvements in clean energy use and efficiency since past several decades have transpired because of advances in economic freedom and trade liberalization, rather than government regulations.

Indexes like EFW, SPI and EPI suggest that developed countries are doing better than developing countries in terms of environment. The reason is poor countries are compelled to exploit their natural resources in order to develop because they lack the financial wherewithal to do otherwise, while on the other hand good policy outcomes are linked to prosperity and increasing GDP, implying that economic success allows countries to engage in policies and programs that provide desired results. Market supporting institutions and EF concepts such as free markets, rule of law, free trade, and protection of private property rights, generate development and lower costs for nations and allow them to better preserve the environment, and increase approach to quality education. Hence, for a better world, with quality air and environment for the wellbeing of humanity, we must ensure EF policies and market supporting institutions.

Degradation of the environment has a detrimental influence on human health. The average lifespan of people is decreasing as a result of the deterioration of environmental quality (air, water, and land). Even though it is impossible to know exactly how environmental variables contribute to the development of mortality and disease, the WHO estimates that thirteen million people die each year because of avoidable environmental causes. In third world countries, the environmental burden of disease is 15 times greater than in developed economies, owing to different levels of exposure to externalities. Due to the manufacturing of low-quality goods and polymers laced with chemicals, thus industrial operations pollute the environment. Others include unlawful disposal, which has negative consequences for the ecosystem and environment. For this purpose, we need to develop the market supporting institutions and EF that supports sustainable development, as per statistics countries with more economic restrictions and poor market supporting institutions suffers more from the poor environment quality. However, the problem is that the policies and regulations that are enforced in order to keep the environment clean and the provision of subsidies and insurance policies for public, in order to provide better and cheaper healthcare on the contrary has developed government monopolies and on the other hand sell off the rights to big corporations, favoring one over another, which discourages the businesses and affects the economy badly by attracting bad investments.

Considering the factors contributing towards environmental degradation. It is worth to mention that the most important of these factors might be the lack of good MSIs. While inquiring the existing theoretical and empirical literature on the mentioned issues, it is apparent that only few studies have focused on the correlation between market supporting institutions and environmental outcomes. Thus, this study addresses this issue by analyzing the impact of market supporting institutions on environmental emissions. In terms of its contribution to societal wellbeing, we already know that EF, or the ability to engage in economic activity, does not negate the government's power to intervene. It is the government's responsibility to take remedial action in order to guarantee that the people receive maximum advantages and also that society is equitable. Likewise, Bronfenbrenner (1955) concluded in his study that offering public services, implementing rules and regulations (including environmental stewardship), safeguarding rights of people, maintaining a stable economy, as well as enforcing less restrictions on free trade and commerce are all strategies to guarantee that markets run smoothly.

The government should work to create an environment that is conducive to productive work. The main objective of government involvement, on the other hand, is to create a conducive environment for entrepreneurship that adds to the country's economic stability, wherein one stakeholder does not infringe on the rights of others. Thus, an economically free society allows individuals to spend, consume, and produce freely. EF helps improve the social welfare of the citizens of the country, by providing them with cleaner environment, good entrepreneurial opportunities. The rest of the study is organized as follows: The subsequent section consists of the literature review tracked by the research design. The next section outlines the analysis of the study followed by of conclusion and policy recommendations at last section.

REVIEW OF RELATED LITERATURE

The rapid air pollution has become an alarming concern for the survival of the humanity. Various school of thoughts blame each other's ideologies for this problem, but the major blame has been put on EF by environmentalists and conservatives. They blame free market enterprise, capitalism, and EF for the ongoing destruction of the world and believe that environmentalism and EF have inverse relationship. However, such is not the case as which can be shown by demonstrating that free enterprise is the most effective technique of achieving environmental conservation. Given most environmentalists' concentration

on socialism and their antipathy for capitalism, this appears to be a hard challenge at first. However, the fact that laissez-faire capitalism, and EF is adamantly opposed to invasions or border crossings, and that the environmental disasters and health crisis, from carbon emissions to industrial pollution and waste disposal in air, lakes, rivers, seas, soil, which has resulted in increased poor environmental outcomes, might be because of the inability of government to safeguard property rights and other policy initiatives that either controls or prohibits private property (Walter Block 1998).

According to mainstream economic analysis, "market failure" is the cause for environmental degradation, rather than the government's inability to safeguard private property rights, as they believe market failure is the intrinsic shortcoming of the free-market economy. In other words, mainstream economic analysis blames market failure for the negative externalities, which has resulted in the degradation of environment, rather than poor quality of market supporting institutions or government's inability to internalize the externalities. Moreover, there comes some other economic theories that believe that the only way to control environmental degradation is through strong market supporting institutions, where government supports sustainable economic growth and free enterprise, along while enacting the policies to internalize the externalities, invests in human capital and information and technology and promotes entrepreneurial projects that paves way for environmentally friendly innovations, which is the only way to curb on the problem of environmental degradation, by shifting towards clean energy.

Market supporting institutions help a great deal in achieving higher economic growth, which in turn helps in lowering the environmental concerns. Free market supporters or libertarian philosophers like Walter Block (1998) puts blame on the government failure rather than market failure, for the environmental degradation. As according to him, if government could properly safeguard private property rights from private polluters, contamination from industries would have never happened in the first place. The EKC is frequently used to demonstrate this link. Under developed countries are enforced to abuse their environment as they develop because they cannot afford to protect it from pollution. Furthermore, with time, many underdeveloped nations gain a degree of revenue as a product of this exploitation that enables them to fund environmentally friendly industrial methods and increase public funds committed to environmental conservation. Environmental quality improves in tandem with increases in per capita income (Perkins et al. 2001).

Furthermore, "Pollution halo hypothesis" also supports the idea that market supporting institutions and EF positively impacts environmental outcomes, as it argues that through foreign direct investment (FDI), multinational corporations transfer their clean and greener technologies to host countries. Green technology, such as pollution controlling technologies and renewable energy technologies, could be transferred, as well as advanced energy saving technologies that cuts down the demand for traditional sources of energy like fossil fuels. Thus, the hypothesis supports free trade policies, which is one of the key elements of market supporting institutions and EF.

Moreover, there are some other theories that indirectly backs the argument that market supporting institutions have positive impacts on environmental outcomes, which includes "new growth theory". This theory focuses on the investment by government in technology, knowledge, and entrepreneurship, which paves ways for environmentally friendly innovations, which automatically promotes sustainable economic growth. In other words, stronger market supporting institutions and rising levels of innovation have a positive link, suggesting that greater potential to address environmental challenges is accessible. The positive outcome of this important relationship is a virtuous cycle of investment (especially in green and sustainable technologies), innovation, and more strong, inclusive economic growth.

Similarly, free market environmentalism is a newer phenomenon, Walter E. Block (2013) argued in Free Enterprise Environmentalism that laissez-faire capitalism is more efficient than socialism and government regulation in addressing climate change. Anderson (2019) explained the phenomenon of free market environmentalism in simple term of "healthier is wealthier". While further explaining the term he puts that, the primary assumption of FME is that markets create revenue that allows us to tackle environmental challenges. Conversely, welfare economists believe that it is market failure that has resulted in the environmental degradation rather than government failure. They deemed government intervention and environmental taxes very necessary for keeping the industries from causing environmental degradation. Arthur Pigou (12017) justified government intervention for the welfare of the major society, his book "Economics of Welfare".

Similarly, pollution haven hypothesis argues against the open trade, market supporting institutions, and EF stating that because of open trade and EF, industrialized developed countries with strict environmental laws and policies, transfers their polluting industries through foreign direct investment (FDI) in developing countries because of their lack of no environmental policies, consequently making them "pollution havens". Carlsson & Lundström (2003) explored the influence of politico-economic freedom on environmental emissions. It was the first research of its kind to look at the link between EF and environmental quality across countries. EF could be measured in various ways. They discovered that improved price stability and legal framework reduce emissions in nations with a smaller industry share of GDP but boost emissions in countries with a big industry share of GDP. Increased market activity had a substantial but non-robust decreasing effect, whereas increased trade freedom had no such major impact. Political freedom had minimal impact on CO2 emanations, owing to the fact that CO2 emissions are a worldwide environmental concern.

Yameogo et al. (2021) explored the correlation between globalization, environmental outcomes and institutions in Sub-Saharan Africa. Utilizing data for the period 2002-2017 and using GMM, the results expose that regulatory quality has a favorable influence on environmental degradation in Sub-Saharan Africa, but economic globalization and corruption control have a negative impact. The study believes on tight trade policies for ensuring sound environment. Saint Akadırı et al. (2021) tried to uncover

the EKC assumption and found that it is only supported in the long run when economic freedom (EF) is used instead of economic growth. Significantly, when both EF and output are used together, they have the same carbon mitigation effect in both the short and long run. Mahmood et al. (2021) explored the link between energy intensity, economic liberty, and carbon emissions. The data has been collected from the forty-one Asia-Pacific economies that represent all World Bank income categories, for scrutinizing the problem of environmental concerns, EF, and energy use. EF has a direct influence on the environment and energy in the presence of income, as well as a moderating effect.

Using the autoregressive distributed lag technique, it was experimentally evaluated for a panel of 41 Asia-Pacific nations. While there is no bidirectional correlation between any of the variables, the findings indicate that the long-run outcomes of EF for the economy and the environment are positive. The findings point to significant structural improvements in Asia-Pacific countries, as well as a favorable economic and regulatory environment. In addition, Tahir et al. (2021) compared economic liberalism with economic federalism in order to examine the problem of air pollution in the Asia-Pacific area. They concluded that government expenditure, taxes, and other financial health policies may be employed as significant sources of air pollution prevention and control in the Asia-Pacific area. We conclude our literature review by stating that there are different views about the nature of relationship between market supporting institutions and environmental outcomes. Conservatives initiate a negative link between MSIs and environmental outcomes, while liberals believe of a strong positive relationship between market supporting institutions and environmental outcomes. Thus, we aim to find a neutral way through which we can establish the true nature of the nexus between market supporting institutions and environmental outcomes, which can help resolve many environmental concerns around the world, while keeping up the sustainable economic growth.

ECONOMETRIC MODEL

The present study utilizes the given model for encountering the impact of market supporting institutions on environmental outcomes as below:

$$CO_{2_t} = \varphi_1 + \varphi_2 MSI_t + \varphi_3 GDPPC_t + \varphi_4 Pop_t + \varphi_5 EUSE_t + \varphi_6 IS_t + \varepsilon_t \quad \text{eqn (1)}$$

Where CO_2 concentration is measured in parts per million and MSI represents the Market supporting institutions as illustrated by economic freedom which has four major variables, namely, rule of law, size of the government, efficient regulation, and economic openness. In addition, we have taken the control variables as GDP per capita (GDPPC), population Pop); energy use (EUSE) and industrial share (IS). Data has been selected from World Development Indicators (WDI) and the availability of data is determining the sample time period.

ANALYSIS & DISCUSSIONS

Addressing the model along with estimation technique, we are proceeding towards the detailed analysis of the study as below:

Descriptive statistics and graphical illustrations

After identifying the econometric framework as well as the data sources as mentioned in previous section, the data statistics are incurred. Table No: 01 displays the descriptive statistics by recording the mean, standard deviation, minimum and maximum for each series; carbon dioxide emissions (metric tons)/capita and CO_2 production from electricity and heat production, total (% of total fuel combustion), market supporting institutions (economic freedom index-MSI), GDP per capita (current US $), Urban population; Energy use (kg of oil equivalent per capita) and industrial share. We find that all of the given series are having positive means with significant amount of environmental pollution (specifically the carbon dioxide emissions from electricity and heat production) and market supporting institutions. Afterward, we proceed towards the time series outcomes of given variables.

Table 1

Summary statistics

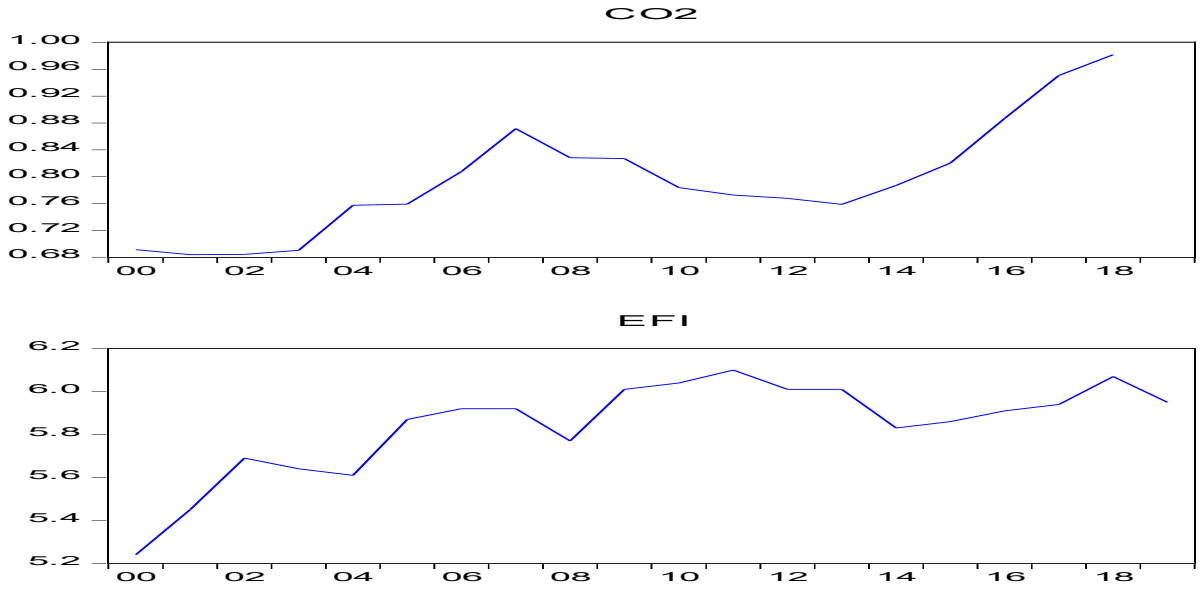
Variable(s)	Mean	Std. Dev.	Min	Max
LCO_2	0.795202	0.084452	0.683731	0.981820
LCO_2_ETOT	3.4928	0.0562	4.4192	3.5968
LEFI	1.7643	0.0383	1.6563	1.8082
LGDPPC	6.8624	0.3443	6.2809	7.3012
LU_POP	3.0055	0.0178	2.9803	3.0410
LENUSE	6.1460	0.0350	6.0873	6.2154
LIND_GDPG	4.4076	4.4524	-5.2068	17.3741

Source: Authors calculations

In order to further illustrate the trends of the concerned variables, we also present the graphs of these variables as shown below. From the given figures of carbon dioxide emissions and economic freedom index, it is shown that CO^2 emission has been increased since 2013 onwards while there is continuous ups and downs in the trends of economic freedom index.

From these graphical illustrations, we can't conclude the exact relationships between the market supporting institutions and environmental outcomes. Thus, we have to perform the time series analysis in order to explore whether market supporting institutions carry any significant impact

on environmental outcomes as proceed below.



Stationarity tests

The empirical analysis of data obliges the stationary of the series used here to resolve which co-integration strategy is best appropriate to be utilized. Accordingly, before the co-integration analysis, we opt to the unit roots testing of the concerned series. We emphasis on the common and widely used strategies such as ADF test proposed by Dickey and Fuller (1979) and the Phillips-Perron (PP) test developed by Phillips and Perron (1988) for judging the stationarity. However, for the small sample data, the former test (ADF) may lack efficiency due to its consideration only on the occurrence of the autocorrelation between variables. Therefore, we apply the PP test, which tests the presence of heteroscedasticity hypothesis in the variables. Moreover, both tests (ADF and PP) are based on the conjecture that tested sequence may contain a constant term and trend variables. The estimated outcomes are illustrated in Table 2. Specifically, all variables are stationary either at I(0) or I(1). Henceforth the mixture of integration order in the form of I(0) and I(1) lead us incapable to apply the standard technique of co-integration, known as Johansen and Juselius (Johansen and Juselius, 1990) and the ARDL bound test popularized by Pesaran et al. (2001a) is the top suitable and effective for this study.

Table 2

Unit-Root and stationarity checks

	Augmented Dickey Fuller (ADF)		Phillips Perron (PP)	
		Level		
Variable	Constant Without Trend	Constant With Trend	Constant Without Trend	Constant With Trend
LCO_2	0.1602	-4.5305**	-0.4714	-1.4930
LCO_2_ETOT	-3.6398**	-3.0638	-2.9714**	-1.2274
LEFI	-3.5946**	-2.9868	-4.5386***	-3.0389
LGDPPC	-1.2842	-0.5422	-1.2966	-0.6806
LU_POP	3.7988	2.2252	-5.6295***	-3.2600
LENUSE	-4.8232***	-4.1752**	-1.4438	-0.8701
LIND_GDPG	-3.0174*	-3.0627	-3.6494**	-5.2252***
		First Difference		
LCO_2	-2.4516	-2.4915**	-2.9876*	-2.9178
LCO_2_ETOT	-3.3180**	-3.5712*	-3.3684**	-5.6999***
LEFI	-4.3583***	-4.6633***	-4.5366***	-6.3212***
LGDPPC	-2.5704	-4.0327**	-2.4950	-2.9430
LU_POP	1.3794	3.9668	1.3997	-2.2024
LENUSE	-2.5824	-2.9484	-2.5824	-3.2822
LIND_GDPG	-1.8788	-3.1152	-10.7052****	-10.3063***
Note: ***, ** and * symbolize significance levels at 1%, 5% and 10% respectively.				

The ARDL co-integration test

We test the existence of cointegration in our series of interests through executing ARDL bounds co-integration strategy while using F-statistics. We find that the F-statistic value of the baseline eqn (1) for our models is calculated which shows that there is significant long run co-integrating relationships between our variables of interest as conveyed in Table (3) below. It is argued that the calculated F-statistic values are higher than the Pesaran et al. (2001a) and Narayan (2005b) tabulated values. Thus, it offers sufficient endorsement to discard the null hypotheses-no co-integration and recommends that a long run relationship exists among our main variables. A different way is to check the value of the co-integrating equation ECT_{t-1}. Specifically, it is maintained that the ECT_{t-1} is statistically significant and carries a negative sign, confirming long run association.

Table 3

Co-integration based on ARDL as per Equation (1)

Model	Dep.Var (s)	AIC lags	F-stat	ECT_{t-1}	Result
Model (1a)	$lnCO_{2t}$	(3,0,0,0,0,0)	9.1182***	-1.0104**	Cointegration
Model (1b)	$lnCO2\_ETOT_t$	(3,0,0,0,0,0)	7.7662***	-0.2438***	Cointegration
Critical Bound Values for F-statistics					
Critical Value for F-statistics (%)		Pesaran et al. (2001)[a]		Nayaran (2005)	
		Lower bound critical value I(0)	Upper bound critical value I(1)	Lower bound critical value I(0)	Upper bound critical value I(1)
1%		3.41	4.68	4.045	5.898
5%		2.62	3.79	2.962	4.338
10%		2.26	3.35	2.483	3.708

Note: [a] Critical values were retrieved from Pesaran et al. (2001) Table CI (iii) Case III: Unrestricted intercept and no trend, p. 300.

Thus, we conclude that in all of the four models, we explore the presence of long run relationships between market supporting institutions and environmental outcomes. This shows that there is possible impact between our variable of interest such as economic freedom index and our dependent variables such as environmental outcomes.

The ARDL estimated results for short runs

While confirming the co-integration of our series of interest, we use the concerned ARDL model to evaluate the short run and long run coefficients. It is worth to mention that we have encountered the environmental outcomes with the CO_2 emissions (metric tons/ capita) and CO2 from electricity and heat production, (% of total fuel combustion). The empirical estimated results show that market supporting institutions as exhibited by economic freedom index has a negative and statistically important impact on CO_2 production (metric tons/capita) at the 1% level. The same negative effect of market supporting institutions is also hold on CO2 emissions from electricity and heat production but at 5% level of significance. The short-run elasticity of CO_2 emissions, with respect to market supporting institutions as measured by economic freedom index, is 1.69, signifying that for each 1 percent increase in size of economic freedom index, CO_2 emissions per capita decreases by 1.69%. Notably, the short run effect is enough large. The estimated results derive that in the short run, the concentration of carbon dioxide emissions from electricity and heat production, is reduced by the increase in the size of economic freedom index. The short run impact is 1.35, suggesting that a 1% increase in economic freedom is combating the environmental emissions from electricity and heat production by 1.35%. Thus, we derive that in the short run time period, the increase in market supporting institutions is deteriorating the environmental pollutions. Unlikely, the CO_2 emissions per capita is carrying negative effect in lagged manner as illustrated from lag 1 and 2. Still, it is shown that CO_2 output from electricity and heat production is positively contributing in lagged manner as observed from the two years lags. Importantly, the economic growth as represented by GDP per capita carries augmented role for CO_2 emissions but the effects becomes negatively insignificant as observed for carbon emissions from electricity and heat production. The estimated coefficient of GDP per capita dictates that a 1% increase in GDP per capita is enhancing CO_2 emissions per capita by 0.28%. In addition, urban population is carrying negative but insignificant impact on CO_2 emissions per capita as well CO_2 emissions from electricity and heat production. The positive and significant coefficient of the energy use shows that energy use is positively contributed towards CO_2 emissions per capita and the same also hold for CO_2 emanations from electricity and heat production but with insignificant impact. The magnitude of the impact of energy use is large (2.25) and consistent with theory as heavy use of energy leads towards more environmental deterioration. In contrast, share of industrial sector is negatively affecting both the CO_2 emissions per capita as well as CO_2 output from two sources. The reason behind this may be the under-developed industrial sector of Pakistan and the structure of industrial sector. The long run relationship is sustained by the coefficient of the lagged error-correction term, which is negative and statistically significant for both the variables measuring the environmental pollution, as expected. The both, short run results suggest that higher level of market supporting institutions as measured by EFI lead to environmental upgradation in Pakistan as evidenced by Khan et al. (2022) and Mahmood et al. (2021) on account of the freedom-environment association.

Table 4

Short run ARDL model estimates

Dependent variable: Alternative measures of CO_2

Variable (s)	Model (1a) LCO_2	Model (1b) LCO_2_ETOT
Constant	-24.9020** (4.4904)	29.2360*** (2.8572)
$\Delta LCO_2(-1)$	-0.5221** (0.1220)	
$\Delta LCO_2(-2)$	-0.4180* (0.1765)	
$\Delta LCO_2\_ETOT(-1)$		0.6868** (0.1584)
$\Delta LCO_2\_ETOT(-2)$		0.6202** (0.1792)
Δ_{LEFI}	-1.6908*** (0.2628)	-1.3532** (0.3067)
Δ_{LGDPPC}	0.2848** (0.0643)	-0.2462 (0.1074)
Δ_{LU_POP}	-2.6312 (6.6485)	-0.8065 (7.1496)
Δ_{LENUSE}	2.2506*** (0.1478)	0.2804 (0.3383)
Δ_{LIND_GDPG}	-0.004** (0.0009)	-0.0066*** (0.0014)
ECT (−1)	-1.0103** (0.1818)	-0.2438*** (0.2200)

Note: Standard errors are in parentheses. See note under table-2

Estimated outcomes of ARDL model for long run

Additionally, checking whether market supporting institutions has similar long run effect on the each measure of CO_2 emanations. Table-05 reports the estimating outcomes of our baseline equations by substituting each measure of CO_2 emissions. The results show that our variable of interest, EFI has a desired and substantial effect on nearly all measures of CO_2 emissions outcomes. These include the negatively significant coefficient of MSIs as 1.92 with dependent variable as CO_2 emissions and negatively significant coefficient of 0.72 with the dependent variable as CO_2 productions from electricity & heat production. Notably, the effect of economic freedom on CO_2 emissions is reasonably higher. Arguably, Pakistan can experience substantial benefit from market supporting institutions to reduce pollution.

Considering the impact of control variables, it is found that both GDP per capita and urban population have positive (negative for second model) effect (but insignificant) on CO_2 emissions and emissions from electricity & heat production. Energy consumption in both cases possess positive impact on environmental emissions as measured by CO_2 emissions and CO_2 emanations from electricity and heat production. However, the effect is only significant for CO_2 emissions, indicating that larger the energy consumption, the greater will be CO_2 emissions. Industry share carries negatively insignificant influence has a negative on CO_2 productions, with the difference that the effect is statistically negatively significant.

Table 5

Long run ARDL model estimates

Dependent variable: Alternative measures of CO_2 emissions

Variable (s)	Model (1a) LCO_2	Model (1b) LCO_2_ETOT
$LEFI$	-1.9171** (0.5551)	-0.7252** (0.2209)
$LGDPPC$	0.2678 (0.1899)	-0.1388 (0.0788)
LU_POP	2.7209 (4.3022)	-2.5818 (1.7276)
$LENUSE$	2.8912*** (0.3949)	0.0760 (0.1462)
$LIND\_GDPG$	-0.0044 (0.0022)	-0.0027* (0.0009)

Note: See note under table 4.

Diagnostic tests of ARDL models

Diagnostic checks are piloted to confirm the validity of the estimated results for statistical inference. The models clear out all the diagnostic checks (see Table 6). In nutshells, all of the assessed models are free from diagnostic issue and specification problems.

Table 6

Diagnostic checks

Model	Serial correlation	Functional form	Normality	Heteroscedasticity
Model (1a)	2.4126 (0.2606)	0.0092 (0.9320)	0.1842 (0.9120)	1.4755 (0.4102)
Model (1b)	0.9463 (0.4333)	15.4796 (0.0589)	1.3204 (0.5168)	0.5844 (0.7584)

Note: Parenthesis are carrying the concerned P-values.

Stability checks of the models

Furthermore, for the stability of the models, CUSUM and CUSUMSQ (Figs.1-2) affirm that our models are econometrically stable over time because both of the recursive lines are in the bound. In short, it is affirmed that market supporting institutions as restrained by economic freedom index has a substantial negative influence on the total CO_2 along with emissions from electricity and heat production.

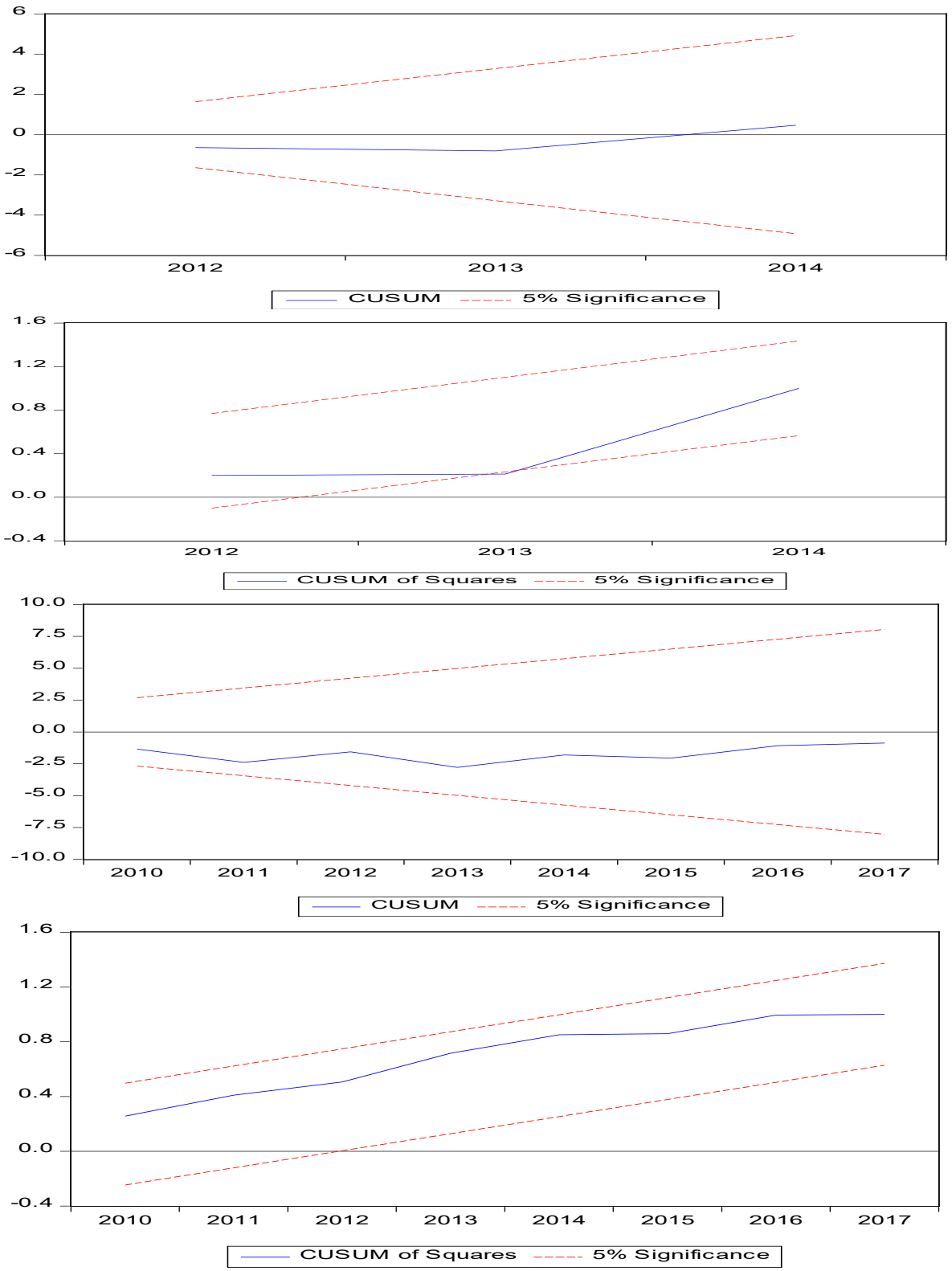


Fig. 1. Model (1a)

Robustness analysis

While to ascertain the robustness of the estimated outcomes of our ARDL models with alternative estimator, the FMOLS and dynamic OLS (DOLS) method are employed. Tables (7) and (8) demonstrate the resulting outcomes respectively. Excitingly, the findings of both estimation strategies, that is of FMOLS and DOLS lies in accordance to our already obtained estimes, both in sign as well as in signifcance. These results are comparable to estimates by ARDL models. For instance, the FMOLS and DOLS estimators elucidate that economic freedom is the negatively

determining the emissions (see table 7&8). The same also implies to the alternative measure of emissions such as from electricity and heat production.

Table 7

Fully Modified Least Squares (FMOLS) estimated results

Variable (s)	Model (1a) LCO_2	Model (1b) LCO_2_ETOT
Constant	5.2460 (6.3247)	34.9362***(5.0155)
$LEFI$	-0.8160** (0.2507)	-2.7016***(0.1988)
$LGDPPC$	-0.1312 ((0.0869)	-0.3417***(0.0689)
LU_POP	-5.3104** (1.9609)	-10.9601***(1.5550)
$LENUSE$	2.0837***(0.1433)	1.4014***(0.1137)
$LIND\_GDPG$	-0.0023**(0.0009)	-0.0104***(0.0007)
R-sq.	0.9562	0.6232

Note: As of table-04.

Table 8

Dynamic Ordinary Least Squares (DOLS) estimated results

Variable (s)	Model (1a) LCO_2	Model (1b) LCO_2_ETOT
Constant	5.0124 (6.0716)	14.9492 (12.5848)
$LEFI$	-0.7798**(0.2876)	-1.3714**(0.5960)
$LGDPPC$	-0.1189 (0.0780)	-0.1296 (0.1617)
LU_POP	-5.1374**(1.8872)	-3.1504 (3.9118)
$LENUSE$	2.0132***(0.1734)	0.2198 (0.3595)
$LIND\_GDPG$	0.0022**(0.0009)	-0.0074***(0.0020)
R-sq.	0.9618	0.6758

Note: See note under table-04.

CONCLUSION

Our study is a pragmatic attempt to uncover the effect of market supporting institutions on environmental outcomes in a typical developing economy-Pakistan. While utilizing time series data and using the traditional Autoregressive Distributed Lags strategy, we found a statistically significant but negative impact of the market supporting institutions as illustrated by economic freedom index on environmental degradation. Importantly, we also found the suppressive effect of these market friendly economic structure on the ecological degradation as generated from electricity and fuel production. The estimated results of the control variables are showing the determinants of environmental pollution as per the conventional wisdom. Overall, this study implies that we can mitigate the environmental degradation through a sound economic institutional framework. Strong market supporting institutions can provide safe and favorable environmental outcomes. Thus, the policy makers must consider the role of market friendly institutional infrastructure while designing strategies for environmental concerns.

Conflict of Interests

The authors has declared that no competing interests exist.

References

Akadırı, S. S., Alola, A. A., & Usman, O. (2021). Energy mix outlook and the EKC hypothesis in BRICS countries: a perspective of economic freedom vs. economic growth. *Environmental Science and Pollution Research*, *28*(7), 8922-8926.

Anderson, D. A. (2019). *Environmental economics and natural resource management*. Routledge.

Block, W. E. (1998). The Necessity of Free Trade. *Journal of Markets & Morality*, *1*(2).

Block, W. E. (2014). Toward a libertarian theory of evictionism. *Journal of Family and Economic Issues*, *35*, 290-294.

Bronfenbrenner, M. (1955). Two concepts of economic freedom. *Ethics*, *65*(3), 157-170.

Carlsson, F., & Lundström, S. (2003). The effects of economic and political freedom on CO2 emissions. *Economic Studies, Department of Economics, School of Economics and Commercial Law, Göteborg University: Gothenburg, Sweden*, 79.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with appucations to the demand for money. *Oxford Bulletin of Economics and statistics*, *52*(2), 169-210.

Khan, H., Weili, L., & Khan, I. (2022). Environmental innovation, trade

openness and quality institutions: an integrated investigation about environmental sustainability. *Environment, Development and Sustainability*, 1-31.

Mahmood, M. T., Shahab, S., & Shahbaz, M. (2022). The relevance of economic freedom for energy, environment, and economic growth in Asia-Pacific region. *Environmental Science and Pollution Research*, *29*(4), 5396-5405.

Perkin, E. K., Hölker, F., Richardson, J. S., Sadler, J. P., Wolter, C., & Tockner, K. (2011). The influence of artificial light on stream and riparian ecosystems: questions, challenges, and perspectives. *Ecosphere*, *2*(11), 1-16.

Perron, P. (1988). Trends and random walks in macroeconomic time series: Further evidence from a new approach. *Journal of economic dynamics and control*, *12*(2-3), 297-332.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Pigou, A. (2017). *The economics of welfare*. Routledge.

Yameogo, C. E., Omojolaibi, J. A., & Dauda, R. O. (2021). Economic globalisation, institutions and environmental quality in Sub-Saharan Africa. *Research in Globalization*, *3*, 100035.