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Does Financial Development, Economic Growth and Industrial Growth Intensify Energy Consumption in Pakistan?

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Abstract: *Pakistan has observed up to 80% increase in energy consumption during last 2 decades. There has been a dramatic surge in the industrial growth rate since 9/11, when foreign aid flooded the national economy. As a result of the highest power demand in the country's history, brought on by rapid industrialization and economic growth, 2007 marked the year when Pakistan experienced its largest power shortfall. This paper investigates the relationship of financial development (FD), economic growth (GDP), exports (EXP) and industrial growth (IND) with energy consumption (EC) in Pakistan. ARDL ECM and Bound testing have been used for this investigation for a data spanning from 1980 to 2021 for Pakistan. A short-run and significant relationship of financial development (FD), economic growth (GDP) and industrial growth (IND) with energy consumption (EC) have been found. Only exports have a significant long-run association with energy use.*

Keywords: Energy Consumption, Financial Development, Economic Growth, ARDL ECM.

Introduction

Understanding the energy consumption and its determinants is an important topic for researchers and policy makers alike. As the global economy and population continue to expand rapidly, so does the demand for energy to power the growing number of factories. Factors such as urbanisation, economic expansion, industrialisation, exports and the level of financial development all have significant impacts on energy consumption (Shahbaz & Lean, 2012; Li & Yuan, 2021). Increased energy consumption may result, for instance, from people's increased propensity to buy televisions, computers, and automobiles as a result of financial development. Similarly, Energy demand and consumption are expected to rise because of increased investment in plant and equipment made possible by financial development.

Considering the mix evidence regarding the determinants of energy consumption the current study aims to revisit these determinants of energy consumption in Pakistan due to peculiarity of this country in this regard. Pakistan has observed up to 80% increase in

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energy consumption during last 2 decades. There has been a dramatic surge in the industrial growth rate since 9/11, when foreign aid flooded the national economy. As a result of the highest power demand in the country's history, brought on by rapid industrialization and economic growth, 2007 marked the year when Pakistan experienced its largest power shortfall. Pakistan is still experiencing electricity shortages in 2023, therefore the situation has not improved considerably. For instance, in summer seasons, the demand for power exceeds generation and transmission capabilities, leading to load shedding lasting 8-12 hours in urban regions and 12-18 hours in rural areas (Khatri et al., 2022). Inadequate power grid investment and financial restrictions are both blamed for energy crises in Pakistan. The fact that Pakistan depends on imports of petroleum and its financial woes add to the bleak outlook. Due to expensive fuel sources, dependency on imported energy, petrol shortages, power sector debt, and obsolete gearbox systems, the energy industry continues to be a major hurdle to economic progress. The energy concerns are made worse by governance issues, inconsistent energy policies, and a lack of long-term planning (Haque, 2023).

Considering the ongoing energy crises and economic difficulties, this study intends to explore the complex relationships between financial development, economic growth, industrialisation, exports, and energy consumption in Pakistan. Particularly, the study intends to answer the following questions. What are the complex links between financial development, economic growth, industrialization, exports, and energy consumption? How do these determinants interact and influence energy consumption patterns? How can the insights gained from this study be used to inform policy decisions aimed at managing energy consumption and supporting sustainable economic development in Pakistan? By answering these important questions, the study intends to provide valuable insights for policymakers and stakeholders to formulate effective strategies that address the energy-related challenges while promoting overall economic advancement in the country.

The literature is divided about the impact of financial development on energy consumption. It is widely agreed upon by academics that higher energy consumption correlates with higher financial development (Gaies, Kaabia, Ayadi, Guesmi, & Abid, 2019; Ho, Wu, Rivas, & Nguyen, 2019; Mukhtarov, Mikayilov, Mammadov, & Mammadov, 2018). However, this positive impact is prevalent only in developing countries not in developed countries. There is no strong linear relationship between financial development and energy consumption. However, these two have nonlinear relationship. Initially financial development increases the energy demands but energy consumption declines when financial sector matures and invest in more energy efficient projects i.e., Reversed u-shaped relationship (Gaies et al., 2019). On the other side, several researchers have demonstrated that financial development has a detrimental impact on energy usage.

The second important variable for energy consumption is economic growth (GDP). Consumer purchasing items directly increases the demand of energy consumption. Increase in demands leads to increase in production and leads to construction of new plants and factories. As the economic growth rises then there is also an increase in energy consumption. Gómez and Rodríguez (2019); Shahbaz and Lean (2012) shows positive relationship of GDP with energy consumption. However, studies e.g., Farhani and Solarin (2017) find that increases in real GDP reduce energy demand in both the short and long run. Chen, Chen, Hsu, and Chen (2016) conclude that Energy consumption has a detrimental influence on GDP in developing countries and the global economy, but not in developed countries.

Industrialization and exports are also the important variables for energy consumption as increase in both increases the demand for energy consumption. Empirical findings show a positive relationship between industrial growth and energy consumption. But, the relationship strength is depend upon industrial development and energy consumption level, causing the variations among different periods and also regions (Li & Yuan, 2021). Considering the mix evidence regarding the determinants of energy consumption the current study aims to revisit these determinants of energy consumption in Pakistan due to peculiarity of this country in this regard. Pakistan has observed up to 80% increase in energy consumption during last 2 decades. There has been a dramatic surge in the industrial growth rate since 9/11, when foreign aid flooded the national economy. As a result of the highest power demand in the country's history, brought on by rapid industrialization and economic growth, 2007 marked the year when Pakistan experienced its largest power shortfall. While much has been learned about energy consumption, much more must be done to solve Pakistan's growing energy demand, the root of the country's power shortages since 2007. Thus, the current study aims to fulfill this gap. Specifically, The purpose of this research is to examine the connection between financial development, economic growth, industrialization, and exports, and energy consumption.

The study makes several fold contributions. It augments growing literature on energy consumption. The findings can be beneficial for policy makers as they can focus specific areas to manage energy consumption.

Literature Review

The production of numerous goods and services has increased along with the economy's and population's fast expansion, which has led to an increase in energy consumption. So for a variety of reasons, energy use and its influences are a hot issue for many academics. The link between FD and EC remains complicated and inconclusive within the existing literature. Diverse findings are seen across different countries, varying the ways in which FD has an influence on energy consumption. Both cross-country studies and analysis of a single country are included in research. While some studies indicate a positive link among FD and Energy use (Gaies et al., 2019; Mukhtarov et al., 2018; Sadorsky, 2010), and argue that FD increases EC by facilitating business expansion and boosting consumer spendings. Others report negative or insignificant impacts (Ali, Yusop, & Hook, 2015; Farhani & Solarin, 2017; Gómez & Rodríguez, 2019), and contend that FD fosters innovation in energy-saving techniques and efficiency. Various indicators are used to measure FD, such as the percentage of internal private sector credit in GDP, bank deposit money, assets to GDP, and FDI. Different econometric approaches and methodologies are employed. The different economic models like, ARDL models, VECM, (GMM) models, and nonlinear models used (Yue, Lu, Shen, & Chen, 2019). The existing literature exhibits some limitations, primarily focusing on specific countries and using different indicators and methodologies to explore the FD and EC nexus.

Sadorsky (2010) utilized data from 22 emerging nations spanning the years 1990-2006. Utilizing stock market indicators in relation to GDP. the main goal was to analyze the impact of FD on EC. The findings showed a link between increase levels of FD and rising levels of energy use. Shahbaz and Lean (2012), conducted a research study utilizing data spanning from 1971 to 2008. They examine the association between EC, FD, urbanization, industrialization, and economic development in Tunisia. They employed ARDL bound test and Granger causality tests as analytical tools. The results of their research affirm the presence of a sustained connection among EC, FD, and industrialization. Notably, the study discovered bidirectional causalities in the long run between FD and EC (Energy Consumption).

Islam, Shahbaz, Ahmed, and Alam (2013), employed ARDL and VECM Granger Causality models to examine the interaction among EC, FD, aggregate production, and population in Malaysia. The investigation encompassed the time frame from 1971 to 2009. The outcomes of this research indicate the long term and also the short-term variations in EC are influenced by economic and FD as well as economic growth. Furthermore, a bidirectional short-term relationship was discovered among these variables. The study also found that population growth and EC have a single, long-term link.

Financial development and energy consumption have a long-run relationship according to Mukhtarov et al. (2018), by employing cointegration technique using data ranges from 1992-2015, he found the significantly positive effect of financial development on energy consumption. Wang, Su, Li, and Ponce (2019), use impulse response function and granger causality to test the effect of energy prices, GDP and urbanization on the per capita energy consumption. Data from 1980 to 2015 for 186 countries for different income groups have been taken for this purpose. Bidirectional relationship urbanization and energy consumption have been found only in high and lower middle-income countries. Bidirectional causal relationship between GDP and energy consumption found. Impulse response function shows a negative relationship between energy prices and energy consumption in high- and middle-income countries, whereas this effect is positive in upper income countries.

Gaies et al. (2019), use Dynamic panel GMM models to report the financial development impact on energy consumption. Data taken from 1996 to 2014 of MENA countries. The results from linear model show a positively significant effect of financial development on energy demand, whereas a inverted u-shaped relationship found from non-linear models. The u-shaped relationship show that initially financial development increases energy demands but energy consumption declines when financial sector matures. Ho et al. (2019), test the association between energy consumption, GDP, and population in Vietnam from 1985 to 2015. VECM and Granger causality test are applied for this purpose. The results show the cointegration between the variables. Unidirectional causality has been found from population towards energy consumption and gross domestic product, and also from energy consumption towards GDP. Yue et al. (2019), uses SIRPAT and PSTR model to check the linear and non-linear relationship between energy consumption and financial development from 2006 to 2015 for 21 transitional countries. By considering different indicators of financial development, they found no linear relationship with energy consumption, but found a significant non-linear effect on energy consumption. From the results a significantly positive impact of economic growth and population on energy consumption is found.

Hussain, Ahmad, and Ahmad (2022) employs a panel autoregressive distributed lag (PARDL) technique. Found a significantly positive association among CO2 emissions and EC in the short and long term. Additionally, both short- and long-term outcomes are positively and strongly correlated with the GDP and GDP squared coefficients. Mukhtarov, Humbatova, Seyfullayev, and Kalbiyev (2020), employed the VECM methodology to scrutinize a data spanning the years 1993 to 2014. Their focus was on examining how FD and economic growth influence EC from the perspective of Kazakhstan. Their analysis revealed a statistically significant impact of both FD and economic growth on EC. However, they also identified a detrimental impact of energy prices on EC. Ulucak et al. (2021), asses the relationship of financial development and globalization with energy consumption from 1980-2017 in Pakistan. Use BARDL method to investigate this relationship. The results confirms that both of financial development and globalization have a significantly positive relationship with energy consumption in Pakistan.

Mukhtarov, Yüksel, and Dinçer (2022) examine the effects of financial development, energy pricing, and economic growth on energy consumption. Used VECM and ARDL techniques to analyse data for Turkey spanning the years 1980 to 2019. The results indicate a noteworthy correlation between financial development and renewable energy consumption. According to the data, a 1% rise in financial development is thought to be associated with a 0.21% rise in the usage of renewable energy. To examine the connections between economic growth, foreign direct investment (FDI), financial development, and renewable energy usage in the UAE from 1989 to 2019, (Samour, Baskaya, & Tursoy, 2022) use a bootstrap autoregressive distributed lag together with Granger causality analysis. The study provides solid empirical evidence that the UAE's increased use of renewable energy is significantly influenced by financial development, FDI, and economic growth. Hao (2022) use cointegration and causality model of VECM to examine the relationship among renewable energy consumption, export, output, and CO2 emissions in China from 1990 to 2020 through the lenses of both industry and agricultural. The results demonstrate a persistent correlation and causal connections between these elements. The tests show that CO2 emissions, exports and usage of renewable energy have a two-way cause-and-effect relationship over time.

Conversely, in a different study, (Ali et al., 2015) utilized ARDL bound testing to investigate the influence of FD, and economic growth on EC within Nigeria. Their investigation spanned from the first quarter of 1972 to the last quarter of 2011. Their findings revealed a notably adverse influence of FD and economic growth on usage of fossil fuels in the short term. Notably, other researchers have also uncovered a inverse relationship between FD and EC. In a similar vein, (Farhani & Solarin, 2017) adopted RALS regression and Bayer-Hanck CR techniques to delve into the interconnections and long-term associations among FD, FDI, economic growth, trade capital, and EC/demand. Use data from the US ranging from 1973Q1-2014Q4. Their findings show an adverse impact of FDI, real GDP, and FD on ECs. Similar findings were made by Gómez and Rodríguez (2019). Likewise, stumbled upon a negative connection among FD and EC, alongside a positive correlation between GDP and energy EC. Their exploration encompassed the association between EC, FD, economic growth, and urbanization across NAFT member countries from 1971 to 2015. They use fully modified OLS and Dynamic OLS methodologies to scrutinize this complex relationship. Ma and Fu (2020), employed panel data including 120 nations, spanning both developing and developed economies. They utilized the GMM method to investigate this association. The conclusion of their empirical analysis reveals an augmentation in EC due to FD. However, this phenomenon primarily manifested within developing countries. In contrast, the impact of FD on EC in developed nations was not as pronounced. Mahalik, Babu, Loganathan, and Shahbaz (2017), explored the connection among FD and EC in Saudi Arabia. they use a data set from the period spanning 1971 to 2011. The analysis encompassed additional determinants of EC, such as capital EC and economic growth. The study established that FD contributes to increased EC over the long term. Additionally, a negative correlation was identified between EC and economic growth.

Data and Methodology

The study relies on yearly data from the International Monetary Fund (IMF), the World Bank, and Ener, which spans 1980 to 2019. Kilograms of oil equivalent are used to measure energy usage. Credit to the private sector as a fraction of GDP serves as a proxy for financial development. The real Gross Domestic Product (GDP) growth rate is a used as an indicator of economic growth. Total exports are reported in US dollars. Industrial value-added growth, not percentage growth, serves as a proxy for industry expansion. Energy Consumption, Financial Development and Exports are used in natural logarithmic form.

The Autoregressive Distributed Lag (ARDL) method introduced by Pesaran, Shin, and Smith (1999) and expanded by Pesaran, Shin, and Smith (2001) has employed to investigate relationship between energy consumption and economic growth. The ARDL's unique strength i.e., its ability to handle different lag structures across variables (Menegaki, 2019) is the primary motivation for selection of this model. The model excels in capturing complex interplay between variables, especially in cases of regime shifts and unexpected shocks.

The following empirical model described the association between dependent variable Energy consumption (EC) and independent variables financial development (FD), exports (EXP), economic growth (GDP) and industrial growth (IND).

$$EC = f(FD, EXP, GDP, IND) \tag{1}$$

$$EC_t = \beta_0 + \beta_{FD}FD_t + \beta_{EXP}EXP_t + \beta_{GDP}GDP_t + \beta_{IND}IND_t + \mu_t \tag{2}$$

In equation (2), β_0 stands for a constant, betas for the variable coefficients, and μ for the error term. We utilised the ARDL bound test to cointegration to examine the variables' long-term correlation (Pesaran et al., 2001). The following empirical model used by Shahbaz and Lean (2012).

Table 1
Summary of the empirical findings

Empirical Works	Time Period	Methods	Results
Sadorsky (2010)	1990-2006	GMM	Financial development leads to raise the energy consumption.
Shahbaz and Lean (2012)	1971-2008	ARDL Bound Testing, Granger Causality	Bidirectional causalities have been found between FD and energy consumption in the long run
Islam et al. (2013)	1971-2009	ARDL and VECM G ranger Causality	Energy consumption is affected both in the long and short run by financial development and economic growth
Mukhtarov et al. (2018)	1992-2015	VECM Cointegration	Significantly positive impact of financial development on energy consumption
Yue et al. (2019)	2006-2015	SIRPAT & PSTR	significantly positive effect of economic growth and population on energy consumption.
Gaies et al. (2019)	1996-2014	Dynamic Panel, GMM	Positively significant effect of financial development on energy demand
Ho et al. (2019)	1985-2015	VECM and Granger causality	Unidirectional causality has been found from population towards energy consumption and GDP
Wang et al. (2019)	1980-2015	IRF, Granger Causality	Bidirectional causal relationship found between GDP and energy consumption found.
Ma and Fu (2020)		GMM	Financial development increases energy consumption in developing countries, whereas there is no such obvious effect of financial development on energy consumption in developed.
Mukhtarov et al. (2020)	1993-2014	VECM	Statistically positive impact of financial development and economic growth on energy consumption have been found
Ulucak et al. (2021)	1980-2017	BARDL	Financial development and globalizations have a significantly positive relationship with EC
Li and Yuan (2021)	1995-2017	Quantile-on-Quantile approach	Industrialization has positive relationship with energy consumption.
Cao et al. (2022)	1980-2018	ARDL	Significantly positive impact of FD on EC.
Mukhtarov et al. (2022)	1980-2019	VECM and ARDL	Significantly positive effect of FD on renewable energy consumption.
Shahbaz, Sinha, Raghutla, and Vo (2022)	2000-2019	Second generation methodological approaches	FD is positively associated with renewable energy consumption.
Ali et al. (2015)	1972Q1-2011Q4	ARDL Bound Testing	Found a significantly negative effect of financial development
Mahalik et al. (2017)	1971-2011	ARDL	Financial development adds energy consumption in the long run. While negative relationship found between energy consumption and economic growth.
Farhani and Solarin (2017)	1973Q1-2014Q4	RALS, Bayer-Hanck CR	Found a negative impact of FDI, real GDP and FD on energy consumption.
Gómez and Rodríguez (2019)	1971-2015	Fully modified OLS, Dynamic OLS	Negative association between FD and energy consumption and a positive relationship between GDP and energy consumption.

$$\Delta EC_t = \lambda_1 + \lambda_2 EC_{t-1} + \lambda_3 FD_{t-1} + \lambda_4 GDP_{t-1} + \lambda_5 EXP_{t-1} + \lambda_6 IND_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta EC_{t-i}$$
$$+ \sum_{j=0}^{q} \lambda_j \Delta FD_{t-j} + \sum_{k=0}^{r} \lambda_k \Delta GDP_{t-k} + \sum_{l=0}^{s} \lambda_l \Delta EXP_{t-l} + \sum_{m=0}^{t} \lambda_m \Delta IND_{t-m} + \mu_t \quad (3)$$

$$\Delta FD_t = \alpha_1 + \alpha_2 EC_{t-1} + \alpha_3 FD_{t-1} + \alpha_4 GDP_{t-1} + \alpha_5 EXP_{t-1} + \alpha_6 IND_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta FD_{t-i}$$
$$+ \sum_{j=0}^{q} \alpha_j \Delta EC_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta GDP_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta EXP_{t-l} + \sum_{m=0}^{t} \alpha_m \Delta IND_{t-m} + \mu_t \quad (4)$$

$$\Delta EXP_t = \beta_1 + \beta_2 EC_{t-1} + \beta_3 FD_{t-1} + \beta_4 GDP_{t-1} + \beta_5 EXP_{t-1} + \beta_6 IND_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta EXP_{t-i}$$
$$+ \sum_{j=0}^{q} \beta_j \Delta EC_{t-j} + \sum_{k=0}^{r} \beta_k \Delta GDP_{t-k} + \sum_{l=0}^{s} \beta_l \Delta FD_{t-l} + \sum_{m=0}^{t} \beta_m \Delta IND_{t-m} + \mu_t \quad (5)$$

$$\Delta GDP_t = \delta_1 + \delta_2 EC_{t-1} + \delta_3 FD_{t-1} + \delta_4 GDP_{t-1} + \delta_5 EXP_{t-1} + \delta_6 IND_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta GDP_{t-i}$$
$$+ \sum_{j=0}^{q} \delta_j \Delta EC_{t-j} + \sum_{k=0}^{r} \delta_k \Delta EXP_{t-k} + \sum_{l=0}^{s} \delta_l \Delta FD_{t-l} + \sum_{m=0}^{t} \delta_m \Delta IND_{t-m} + \mu_t \quad (6)$$

$$\Delta IND_t = \phi_1 + \phi_2 EC_{t-1} + \phi_3 FD_{t-1} + \phi_4 GDP_{t-1} + \phi_5 EXP_{t-1} + \phi_6 IND_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta IND_{t-i}$$
$$+ \sum_{j=0}^{q} \phi_j \Delta EC_{t-j} + \sum_{k=0}^{r} \phi_k \Delta EXP_{t-k} + \sum_{l=0}^{s} \delta_l \Delta FD_{t-l} + \sum_{m=0}^{t} \phi_m \Delta GDP_{t-m} + \mu_t \quad (7)$$

where Δ is the first difference, μ_t represents the white noise or error and λ_t is the constant in equation (3). Multiple regression estimates (p+1) are estimated by the ARDL to determine the best lag for each variable. The best lags for the regression can be chosen with the help of the Akaike information criterion (AIC). Such a criterion is also employed in the unit root test. The null hypothesis of autoregressive distributed lag (ARDL) bound testing for co-integration asserts that there is no long-term relationship between the variables.

$$H_0 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$$

$$H_1 = \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq 0$$

To test for co-integration, two asymptotic critical bounds are employed i.e., lower bound and upper bound. In the first case, I (0) is the lower bound, whereas in the second, I(1) is the upper bound. The long-run relationship will exist, and the null hypothesis of no cointegration will be rejected, if the F statistic value is larger than the upper bound. The no cointegration hypothesis is supported if the F-statistic value is smaller than the lower bound. The model is inconclusive if F is between lower I(0) and upper bound I(1).

Results and Discussions

Application of ARDL requites conduct of unit root test for stationarity. We use ADF (Augmented Dickey Fuller) and PP (Philip–Perron) unit root tests. Table 2 presents the results of both unit tests. Table 2 shows that EC (Energy Consumption), FD (Financial Development) and EXP (Exports) are not stationary and become stationary at first difference in both ADF and PP test. The real GDP growth rate (GDP) and industrial growth rate (IND) is stationary at level. Moreover, Graph-1 show the trends of different variables.

Table 2
Unit Test Results

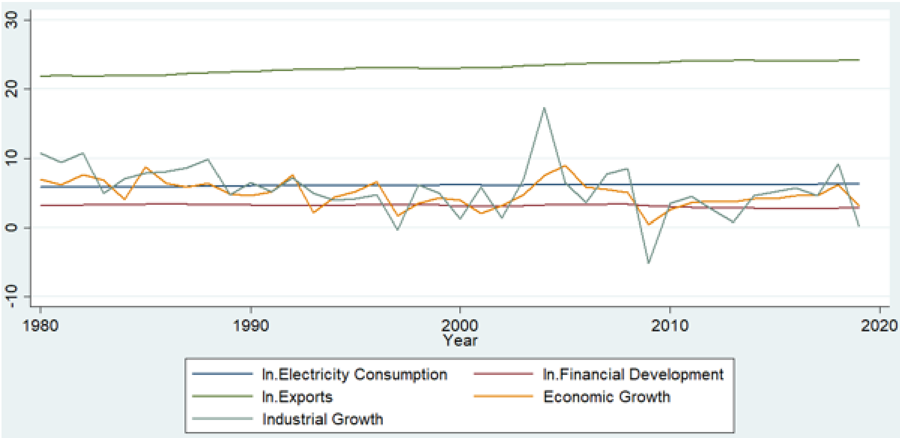
Variables	**ADF Test**		**PP Test**	
	At Level	**1st Difference**	**At Level**	**1st Difference**
EC	-1.892	-3.670 ***	-2.433	-5.097***
FD	-1.053	-3.513**	-0.874	-5.027***
GDP	-4.261***	-8.746***	-4.261***	-8.746***
EXP	-0.863	-4.271***	-1.228	-6.303***
IND	-5.174***	-8.985***	-5.174***	-11.421***

Note: The *** and ** represents the 1% and 5% significance level.

Graph-1 shows the nature and behaviour of the variables. Electricity consumption, exports and financial development are not stationary.

The ARDL autoregressive distributed lag bound testing is used to empirically investigate relationship of financial development, exports, economic growth and industrial growth with energy consumption. Pesaran et al. (2001), highlights the use of autoregressive distributed lag model to estimate the relationship. Once the relevant variable order recognized, then the OLS estimate the relationship of the variables. One of the best merit of the use of ARDL is that, it encompasses stationarity of variables at different levels, either the variables are stationary at level I (0) or at first difference I (1) or mix of I(0) and I(1) but not I(2). For ARDL dependent variable must be at I (1). ARDL clearly distinguished the dependent variable from independent. The modification of the order of different lags variables to correct the serial correlation presence is also a plus point of auto regressive distribute lag model (ARDL) (Pesaran et al., 1999).

Figure 1
Line plots for time-series data



After the unit root tests the next step is to determine appropriate lag level for model. The Akaike information criterion (AIC) is used for the optimal lag selection for the regression. Table 3 presents results for lag selection criteria. It is evident that lag 4 is the optimal lag according to Akaike information criteria.

Table 3
Optimal Lag Length Selection Criteria

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-105.818				0.000325	6.15654	6.2333	6.37647
1	41.7185	295.07	25	0.000	3.60E-07	-0.65103	-0.19045	.66857*
2	63.1439	42.851	25	0.015	4.80E-07	-0.45244	0.391952	1.96683
3	93.3323	60.377	25	0.000	4.60E-07	-0.74068	0.487518	2.77825
4	138.732	90.8*	25	0.000	2.5e-07*	-1.8740*	-.26200*	2.74458

Table 4
ARDL bound test results

Model for Estimation	Lag Length	F-statistics	Lower-upper bound at 1%	Lower-upper bound at 5%	Lower-upper bound at 10%
EC/FD EXP GDP IND	4	3.239	3.74 - 5.06	2.86 - 4.01	2.45 - 3.52
FD/EC EXP GDP IND	4	1.116	3.74 - 5.06	2.86 - 4.01	2.45 - 3.52
EXP/EC FD GDP IND	4	2.017	3.74 - 5.06	2.86 - 4.01	2.45 - 3.52
GDP/EC FD EXP IND	4	7.644***	3.74 - 5.06	2.86 - 4.01	2.45 - 3.52
IND/EC FD EXP GDP	4	0.612	3.74 - 5.06	2.86 - 4.01	2.45 - 3.52

Note: The *** and ** represents the 1% and 5% significance level.

Table 4 presents the F statistic for cointegration ARDL bound test. When the F statistic value is bigger than the upper bound then there is a long run relationship or cointegration between the variables. And if the F statistic value is less than the lower bound then the null hypothesis of no cointegration sustained. Value of F statistic 3.239 from the initial model is below the minimum threshold 3.74 at 1% significance levels, emphasises the lack of a long-term relationship. This indicates the absence of cointegration among the variables and implies a short-term relationship only. As a result, we will proceed with the general ARDL model, as the evidence suggests that the variables do not have a long-term relationship. The F statistic value is 7.644, when the energy consumption (EC), financial development, exports and industrial growth are the forcing variables at lag 4.

Table 5
ARDL test results with optimal lag (4)

Sample:	1984-2019		R^2	0.996
No of obs	36		Adjusted R^2	0.988
Long likelihood	130.1012		Prob >F	0.000
Dependent Variable = EC				
Variables	**Coefficient**	**Std.Err**	**t-statistics**	**p-value**
EC	0.025	0.219	0.12	0.910
FD	0.118	0.371	0.82	0.098
EXP	-0.021	0.079	2.93	0.684
GDP	0.006	0.249	-0.98	0.012
IND	-0.007	0.119	0.85	0.000
Constant	-0.034	0.336	-0.10	0.921

Table 5 presents the results for estimations of ARDL model. It is clear from the results that FD, GDP and IND have a short-run relationship with EC at significant level of 10%, 5%, and 1%. Positive relationship between FD (Financial Development) and EC (Energy Consumption) is similar to that of Gaies et al. (2019); Mukhtarov et al. (2018); Sadorsky (2010). As financial systems grow, they support economic activities like industries and businesses. These activities demand more energy for production and operations, increasing energy consumption. Energy consumption is negatively related to Industrial growth which may be due to technological advancements. As industries develop, they frequently adopt more efficient machinery and equipment. These advances allow them to generate more while using less energy per unit of output, resulting in lower overall energy usage. This negative relationship indicates the progress in technology and the adoption of energy-saving practices in industries. The GDP has positive and significant relationship with energy consumption at 5% confidence interval. This findings is also supported by previous studies of Yue et al. (2019). This implies that as the economy of a developing nation grows and its GDP rises, there tends to be a corresponding rise in the demand for energy resources. This phenomenon is often attributed to the fact that economic expansion typically involves industrialization, urbanization, and increasing production activities, all of which require higher energy inputs. Overall, these findings imply that policy makers need to focus on industrial advancements, GDP growth and financial development in short run to effectively deal with energy consumption in Pakistan.

Table 6
Statistical output for sensitivity test

Durbin Watson	**Breusch-Godfrey LM Test**	**White's Test**	**Ramsey RESET test**
1.9474	0.9855	0.4215	0.2384

The probability values are given in the parenthesis.

The table 6 shows that the model is well specified. Durbin Watson test probability value 1.947 shows no autocorrelation. The 0.9855 of Breusch-Godfrey LM test also do not reject the null hypothesis of having no serial correlation. Homoscedasticity null hypothesis is also not rejected in white's test and the shows that the variables are homoscedastic. There are no-omitted variables according to Ramsey reset test.

Conclusion

A higher output of commodities, and thus higher energy consumption, is necessary to raise people's standard of life. Energy efficiency is supported by the developed financial market. Particularly relevant here is the situation in Pakistan, where the need for energy is rising steadily. The usage of energy has soared by as much as 80% in just the last 15 years. Power requirements rise as economies and industries develop at a rapid pace. Therefore, the article explores the connection between energy consumption and its determinants i.e., exports, economic growth, industrial growth, and financial development.

To evaluate that financial development, exports, economic growth, and industrial growth are all associated with energy consumption or not, the autoregressive distribution lag model is used here. Results are based on data collected from 1980 to 2019. Energy consumption (EC) has been discovered to have a significant but short-term association with financial development (FD), economic growth (GDP), and industrial growth (IND). When industrial growth expands by 1%, energy consumption rises by 0.7%. Furthermore, an increase of 1% in financial development results in an increase of 11.8% in energy consumption. Short-term energy consumption increases by 0.69% for every one percentage point that GDP rise.

An increase in financial development and GDP has a multiplicative effect on energy consumption. For this reason, it is crucial that while formulating energy policies, policymakers consider both the ease with which energy may be obtained and the low cost of energy. If there is no energy crisis in Pakistan, the country's GDP will grow even more rapidly. Government should implement supportive and favourable policies and regulations that encourage energy efficiency in all sectors of the economy. Moreover, it should provide incentives, tax breaks, or subsidies for businesses that invest in energy-saving investments.

Recommendations and Practical Implications

Energy policies that support and facilitate both energy availability and affordability should be given priority by policymakers. Higher output of commodities and economic growth is closely linked to increased energy consumption. Therefore, crafting energy policies that guarantee a stable energy supply is essential to fuel economic growth and industrial advancements. Policymakers should also adopt a holistic approach to sustainable development that takes into account environmental considerations alongside economic growth. This could involve promoting renewable energy sources, energy-efficient technologies, and sustainable industrial practices.

This study emphasizes the significance of a balanced approach to energy policy, economic growth, and industrial development. By considering the interplay between these factors and implementing targeted strategies. Pakistan can work towards achieving sustainable and inclusive development while managing its energy consumption effectively. The promotion of energy efficiency programmes, the facilitation of investments in clean technologies, and the promotion of sustainable energy practices can all be aided by developed financial markets.

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