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Access to Energy Consumption and Economic Growth: Evidence from South Asian Perspective

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ABSTRACT

This study investigates the relationship between energy access and economic growth in selected South Asian economies, i.e., Pakistan, India, Bangladesh, and Sri Lanka, using panel data from 2000 to 2022. Employing a panel ordinary least squares (OLS) framework with robust standard errors and country-specific effects, the analysis distinguishes between different dimensions of energy access, including electricity access, clean cooking fuel access, and per capita energy consumption. The results reveal that while electricity access alone does not exert a statistically significant immediate impact on GDP growth, per capita energy consumption exhibits a strong positive association with economic performance. In contrast, access to clean fuels for cooking shows a weak negative relationship with short-term economic growth, suggesting transitional and structural adjustment effects. Inflation is found to exert a dampening effect on growth, highlighting the importance of macroeconomic stability. Country-specific results reveal substantial heterogeneity, with Bangladesh and India demonstrating stronger growth effects relative to Sri Lanka. The findings underscore that expanding energy access must be accompanied by reliable supply, productive energy use, and supportive macroeconomic conditions to effectively contribute to economic growth. The study provides policy-relevant insights aligned with Sustainable Development Goals 7 and 8.

Keywords: Energy Consumption, Economic Growth, South Asian Countries, Developing Economies

JEL Classifications: Q43, O13, O44, F43

1. INTRODUCTION

Availability of energy is a core element in the light of the socio-economic growth of a particular country. In South Asia, a very substantial number of people continue to be without any reliable and modern energy services, and therefore, it becomes important to analyze the relationship between energy access and economic growth (McCollum et al., 2017). In this paper, four major South Asian countries, Pakistan, India, Bangladesh, and Sri Lanka, are reflected, and they all have diverse characteristics to consider when addressing energy access and sustainable economic growth. The high economic expansion in these nations during the last 20 years has enlarged energy demands, which consequently adds strain on energy infrastructure, governance, and natural resources (Dhar and Shukla, 2015; Shukla et al., 2017; Kumar et al., 2020).

The economy is deeply connected with energy usage since it is a fuel for industrial functions, transportation, and communication networks, which are vital GDP controllers (Rasul, 2016). In South Asia, this nexus is most complex, given the demographic pressures and the environmental vulnerabilities of the region and the developmental disparities. Srivastava and Misra, (2007) affirm that the energy infrastructure should be at the same regional cooperation stage to balance the shortage of energy and the integration of the regional economies. Although conditions have been improving, South Asia continues to struggle with lack of access to clean and affordable energy in many rural and peri-urban regions of the region (United Nations Economic and Social Commission for Asia and the Pacific, 2018) These obstacles are a setback to inclusive growth, most notably in countries like Pakistan and Bangladesh, where energy poverty is high.

Energy access accounts not only for economic output, but also for social welfare. Access to electricity contributes to better educational performance, the work of the health care system, and, more specifically, to the empowerment of women by decreasing the amount of time spent gathering traditional fuels (Dhar and Shukla, 2015; Rasul, 2016; Acheampong et al., 2024). The importance of energy in economic recovery has increased even more in the post-pandemic period. In countries such as Bangladesh and Pakistan, where the informal employment levels are high, reliable sources of energy can spell the difference between the viability of small-scale businesses and cottage industries or otherwise (Lalon, 2020; Rehman et al., 2021).

Although literature on the energy-growth nexus has been widely researched in South Asia, there are still some significant gaps. First, current literature is quite narrow as it deals mainly with aggregate energy consumption but does not take into consideration energy access dimensions, especially the one of electricity access and clean cooking fuel access, which the SDG 7 is all about. Second, the macroeconomic developmental consequences of clean cooking energy transitions have not been researched sufficiently, although they are significant to health, welfare, and productivity in the long-term. Third, most of the research is based on a country study or a time frame, which is a limitation to cross-country comparison and regional extrapolation. Lastly, energy access and macroeconomic instability, especially inflation has little empirical growth models of South Asia. This research paper adds value to the existing literature in the following ways:

1. It collaboratively analyses the electricity access, clean cooking fuel access, and per capita energy consumption in one integrated empirical study.
2. It draws the line between energy access effects and energy usage effects and offers more detailed insights into the dynamics of growth in the short run.
3. It uses country-specific fixed effects to represent heterogeneity within the South Asian economies.
4. It incorporates macroeconomic stability (inflation) on the energy-growth framework, increasing the relevance of the policy.

2. LITERATURE REVIEW

The research on the energy-growth nexus in South Asia is extensive and dynamic. Multiple empirical studies have repeatedly shown that energy consumption and economic growth are positively related in the region. Vidyarthi (2015), in the study on the Data from the South Asian countries from 1971 to 2010 validated that there was a long-run relationship between GDP and electricity consumption. Similarly, the study by Siddique and Majeed (2015), establishes that further developing this relationship in Pakistan, India, and Bangladesh is financial development and openness to trade. According to Ullah et al. (2021), Pakistan's energy-growth paradox is still dependent on fossil fuels; the country suffers energy instability and stagnant growth despite its great renewable energy potential, especially wind and solar. Recently, government properties have been required to install solar panels to rectify this imbalance. Moreover, authors found that improving electricity availability might reduce poverty and boost GDP in Pakistan. Rural entrepreneurship has emerged due to the rise of small-scale solar systems in off-grid territory, making it easier to make money in energy-deficient areas. India has come far in increasing access to energy with the help of significant projects like the Saubhagya scheme and green energy. Lher et al. (2023), in their study, highlighted that large-scale photovoltaic installations, along with the modernization of the current grid, have been a significant factor in enhancing energy equity. This has also helped in industrial and agricultural expansion since it started to integrate energy. Siddique and Majeed (2015), emphasized that India is also playing a pioneering role in enhancing energy cooperation of the region, especially when it has endorsed the SAARC energy project and bilateral cooperation in energy trade with Nepal and Bhutan. As the country faces an increasingly high population growth and widespread urbanization trends, India is still investing in both renewable and conventional sources of power to find a balance between its climate and energy security goals.

The problem in Bangladesh has been how to balance speedy industrialization and the sustainability of energy. There is limited access to clean fuel and electricity to cook and engage in other activities in the countryside, and this touches on full human development (Khan and Gunwant, 2024). According to Khaled et al., (2024) the role of microfinance and infrastructure development was identified as a significant mediator of the important positive impact of electricity consumption on GDP. Sri Lanka, despite its smaller economy, is a good example when it comes to the rate of electrification, which exceeds the mark of 95%. Yet, there are some problems in keeping the energy affordable and less reliant on imported fossil fuels. According to Shukla et al., (2017) the renewable energy incorporated in the grid system of the island nation has played a critical role in creating reliability in the energy sector. A positive relationship between hydroelectric consumption and GDP growth in Sri Lanka is observed, which proves the significance of the domestic renewable assets. Sri Lanka has also started tapping the inventions of wind and biomass energy, aided by people-to-people partnerships and foreign investment. The government has also been able to drive the industrial sector to be energy efficient thus this has also been a further strategic step in lessening the overall energy intensity and achieving a sustainable development (Nishat et al., 2023).

In the extensive literature, macroeconomic factors such as remittances, education, trade openness, and government spending have also been found to improve energy-growth relationships. According to an empirical survey made by Khan and Gunwant (2024), these variables were found to have a substantial dependence in terms of influencing renewable energy production and GDP in the South Asian countries. Finally, the literature affirms a strong connection between the accessibility of energy and economic progress in South Asia. There is much that can be done regionally to work together and establish uniformity in the policies, even though the four countries i.e. Pakistan, India, Bangladesh, and Sri Lanka have selected diverse approaches to address the energy access problem.

3. THEORETICAL FRAMEWORK

Theory of energy consumption is a foundational principle in energy studies. It analyses the patterns and trends of energy use across different sectors of the economy and society. The theory posits that energy is a limited resource and that its proper utilization is essential for sustainable development. The theory examines how individuals or organizations employ energy and the factors that affect energy consumption patterns (Wilhite, 2016). It seeks to elucidate the reasons and mechanisms behind energy utilization, as well as the factors that affect this consumption. A fundamental assumption of the theory is that individuals and organizations are rational agents seeking to maximize their utility through optimal utilization of energy resources (Vosooghzadeh, 2020).

Energy intensity theory examines the connection between energy use and economic activity. It observes energy efficiency across several economic sectors and its impact on productivity and growth. The hypothesis implies that as economies expand, they become more energy efficient, requiring less energy to achieve the same output. This is attributable to industrial and technological advances. Moreover, Energy intensity varies by country and industry, influenced by factors like resource availability, legislative frameworks, and market conditions (Sorrell, 2010; Gershon et al., 2024). The nexus between energy and growth is based on two conflicting perspectives in the literature. Firstly, the initial theory is the typical neoclassical economic growth model, which identifies two critical inputs for economic production: capital and labour. Technological advancement is crucial in fostering economic progress. The second perspective emphasizes that energy from natural resources is a crucial input for production and a source of sustainable economic growth over the long term. Energy is an intermediate input that influences economic growth (Stern, 2004; Omri, 2014; Wang and Wang, 2022). In consideration of the aforementioned, seminal work on the energy-growth nexus revealed that energy is a pivotal determinant of economic growth in the USA (Kraft and Kraft, 1978).

Drawing on energy consumption theory, energy intensity theory, and the energy-economic growth nexus, this study conceptualizes energy as both a direct production input and an indirect enabler of economic activity. Electricity access is expected to influence growth indirectly by enabling productive activities, whereas per capita energy consumption reflects actual utilization in industrial and service sectors, implying a more immediate growth impact. Clean cooking fuel access primarily enhances household welfare, health outcomes, and human capital accumulation, suggesting delayed or indirect macroeconomic effects. Inflation is incorporated to account for macroeconomic instability, which can undermine investment, energy affordability, and productive energy use. These theoretical considerations directly inform the empirical model and expected coefficient signs.

4. METHODOLOGY

4.1. Data Collection

Research philosophy is the fundamental guidelines that guide all phases of research, starting with data collection and analysis, to interpretation (Sekaran and Bougie, 2016). The positivist approach that is used in this study suggests that the reality of things can be observed as objective and can be quantified through solid data. To support this view, the study employs the design of a quantitative analysis and collects data from the database.

This study explores the connection between access to energy and economic growth using data obtained from the World Bank https://data.worldbank.org/from 2000 to 2022 for India, Pakistan, Bangladesh, and Sri Lanka. The selection of these countries is based on the high poverty rate, low economic growth, and the lack of energy resources in Asia. The analysis employs a linear regression model followed by Stata Software to examine the relationship between energy and economic growth. The descriptions and details of the studied variables are reported in Table 1.

4.2. Model Specification

In line with existing area-based literature, this study adopts a "South Asian Perspective" country group to account for differences as well as similarities across the countries in South Asia. In the study dataset of observations from multiple South Asian countries from 2000 to 2022 panel data model is the most appropriate

Table 1: Operationalization of variables

Variables	Measurement	Definition
Dependent-economic growth	GDP growth	GDP growth rate of a country is found to be the reciprocal value of the duration of the period of mean income growth (Kitov, 2008).
Independent - access to energy consumption	Access to electricity (% of population)	Access to electricity is the percentage of people who have access to electricity, based on national and industry surveys and well-known international databases (World Bank, 2018).
	Access to clean fuels and technologies for cooking (% of population)	Proportion of people who primarily use clean cooking fuels and technologies. "Clean" fuels and technologies include electricity, natural gas, liquified petroleum gas (LPG), biogas, ethanol, and solar (World Health Organization).
	Energy use (kg of oil equivalent per capita)	Energy use is the primary energy usage before transformation to other end-use fuels equals indigenous production plus imports and stock adjustments, minus exports and fuels supplied to international ships and airplanes (World Bank).
Control - inflation	Consumer prices (annual %)	The percentage change in the price of a basket of consumer goods and services over a 1-year period is known as consumer prices (annual %), and it represents the rate of inflation that consumers are experiencing (Boskin et al., 1998).
Dummy- country ID	Country Dummy (Individual Country's energy consumption effect on economic growth)	Country dummy variables are binary indicators used to control the fixed effects associated with specific countries. They differentiate the countries' items that can't be observed but remain the same over time (Wooldridge, 2016).

GDP: Gross domestic product

methodological approach (Lee, 2005; Lee and Chang, 2007). In line with the previous similar research, this study considers the "South Asian Perspective," a panel data model is almost certainly the chosen specification; therefore, the general linear regression model is presented below.

$$GDP_{it} = B_0 + B_1\,AE_{it} + B_2\,AF_{it} + B_3\,EU_{it} + B_4\,INF_{it} + CD_i + E_{it}$$

Where:
GDP_{it}= GDP growth rate of country *I* at time *t*,
AE_{it} = Access to electricity (% of population) of Country *I* at time *t*,
AF_{it} = Access to clean fuels and technologies for cooking (% of population) of Country *I* at time *t*,
EU_{it} = Energy use (kg of oil equivalent per capita) of Country *I* at time *t*,
INF_{it}= Inflation - consumer prices (annual %) of Country *I* at time,
CD_I = Country dummy
E_{it} = Error term.

5. RESULTS AND ANALYSIS

5.1. Descriptive Statistics

The descriptive statistics contained in Table 2 explain the central tendency, dispersion, as well as the range of the study variables in 92 observations. The average mean in GDP Growth represents that, on average, all the economies included in the study recorded an annual growth rate of 5.13% between the years of observation. This standard deviation of 2.947 indicates that there is moderate variation in economic growth, in which the minimum level is taken as −7.349, and the maximum value of this is 9.69. It appears that there is heterogeneity in the growth performance as indicated by the spread between minimum and maximum values that could be explained by variations in economic structures, policy frameworks, and macroeconomic stability of the sampled countries (Barro, 2015).

The average of the variable access to electricity AE is 78.925%, and the standard deviation is 16.955. It should be noted that although electricity access is high in the sample countries, it has presented a high disparity between the 32% lower end and complete access (100%). This disparity is a mark of infrastructural disparities and the disparities in energy policy implementation, especially in urban and rural areas (IEA, 2021). In the same measure, the mean of Access to clean fuels and technologies for cooking AF is 29.526 with a comparatively high standard deviation of 14.516, varying observations between as low as 8.3 to as high as 74.5, indicating that in certain contexts, efforts to alleviate energy poverty have been markedly insufficient (World Health Organization, 2020).

The energy use (EU) variable is expressed in kilograms of oil equivalent per capita, with a 413.482 mean consumption with a standard deviation of 139.09. Their span could be found between 135.946 and 712.243. An increase in the values of consumption can possibly relate to increased industrialization or energy-intensive industries, and vice versa, cutting down on consumption can signify efficiency gains or a decrease in industrialization (Sadorsky, 2011). Lastly, the Inflation Rate demonstrates a mean of 7.647%, with a high standard deviation of 5.869, and a wide range of observations from 2.007% to an extreme of 49.721%. This wide variation suggests episodes of macroeconomic instability and price volatility in certain years or countries, potentially linked to exchange rate fluctuations, supply shocks, or political instability in South Asian Countries (Fischer et al., 2002).

5.2. Correlation Analysis

The correlation matrix (Table 3) reports the likelihood of multicollinearity of variables. GDP Growth exhibits weak negative correlations with Access to Electricity (AE, −0.184), access to clean fuels and technologies for cooking (AF, −0.124), and energy use (EU, −0.081), suggesting that higher energy access or consumption does not consistently align to faster economic growth in the studied countries, aligning with evidence on the complex energy–growth nexus in developing economies (Acheampong et al., 2021). Additionally, GDP has a negative correlation with inflation (INF) of −0.388, aligning with empirical evidence from studies that highlight the adverse effects of persistent inflation on growth performance in emerging economies (Shrestha, 2016).

A strong positive correlation exists between access to electricity AE and access to clean fuels and technologies for cooking AF (0.696), signifying that countries with greater electricity access also tend to have higher adoption of clean cooking technologies (Dechamps, 2023). Similarly, a strong positive correlation exists between AE and energy use (EU) (0.719), and between AF and EU (0.808), indicating that improvements in electricity access are often accompanied by cleaner cooking technologies and higher overall energy per capita use (Pachauri et al., 2021). In contrast, Inflation exhibits weak positive correlations with AE (0.146), AF (0.051), and EU (0.063), indicating limited direct association between inflationary trends and energy access. These economic linkages may capture the complex relationship between macroeconomic conditions, energy price, and energy infrastructure investment, which may occur over longer-term horizons (Huntington and Liddle, 2022). Since the correlation coefficients are <0.8, the correlation table demonstrates no multicollinearity between the variables.

Table 2: Descriptive statistics of variables

Variable	Obs	Mean	Standard deviation	Min	Max
GDP	92	5.134	2.947	−7.349	9.69
AE	92	78.925	16.955	32	100
AF	92	29.526	14.516	8.3	74.5
EU	92	413.482	139.09	135.946	712.243
INF	92	7.647	5.869	2.007	49.721

GDP: Gross domestic product, AE: Access to electricity, EU: Energy use, INF: Inflation

Table 3: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)
GDP	1.000				
AE	−0.184	1.000			
AF	−0.124	0.696	1.000		
EU	−0.081	0.719	0.808	1.000	
INF	−0.388	0.146	0.051	0.063	1.000

GDP: Gross domestic product, AE: Access to electricity, EU: Energy use, INF: Inflation

5.3. Variance Inflation Factor

Table 4 gives us the results of the variance inflation factor (VIF) for assessing the existence of multicollinearity among the independent variables in our regression model. If two or more predictors are highly correlated, we have multicollinearity, and this will most likely inflate the variance of coefficient estimates and therefore lower the certainty of our statistical inference (Wooldridge, 2016). A widely used rule of thumb is that a VIF greater than 10 indicates serious multicollinearity, and values over 5 are "high" (O'brien, 2007). In Table 4, all the independent variables have VIF values less than these thresholds, which means multicollinearity is not a major concern for our model.

5.4. Breusch-Pagan/Cook-Weisberg Test for Heteroskedasticity

The Breusch-Pagan/Cook-Weisberg test statistics of the model demonstrate the Test Statistic ($\chi^2[1]$) value of 4.12 with P = 0.0425. The P-value is less than the 5% standard level of significance, indicating that the variance of errors is not constant (heteroskedasticity) and is not normally distributed (Breusch and Pagan, 1979). Considering the variance of the errors is not constant, and heteroskedasticity is present in the model when using values of GDP as the explanatory variable. Significantly, a corrective step is necessary to make a proper inference (Rosopa et al., 2013). Towards ensuring the reliability of the estimation and eliminating heteroscedasticity, as recommended by King and Roberts (2015), a solution is to employ a robust standard error providing valid inference.

5.5. Regression Analysis

The regression results in Table 5 examine the determinants of GDP growth (GDP), considering access to energy variables, inflation, and country dummies as predictors. The model explains approximately 29.1% of the variation in GDP growth ($R^2 = 0.291$) and is statistically significant overall (F-test = 4.169, P = 0.001), this indicates that the explanatory variables together have explanatory power (DINH, 2020). Access to electricity (AE) has a statistically insignificant coefficient (0.006, P = 0.848) among the independent variables. This means that it doesn't have a direct measurable effect on GDP growth, leading to the fact that access to electricity alone, without simultaneous improvements in energy efficiency and productive use, may not produce rapid growth advantages (Stern, 2004). Figure 1 reveals the absence of a clear growth response to electricity access alone, indicating that connectivity without productive utilization may not generate immediate economic gains.

Table 4: Variance inflation factor

Variables	VIF	1/VIF
EU	3.34	0.299
AF	3.134	0.319
AE	2.302	0.434
INF	1.028	0.973
Mean VIF	2.451	0.5063

GDP: Gross domestic product, AE: Access to electricity, EU: Energy use, INF: Inflation, VIF: Variance inflation factor

Figure 2 visually confirms the dominance of energy utilization over access variables in driving growth, while highlighting strong country-specific effects.

Access to clean fuels and technologies for cooking (AF) has a negative coefficient (−0.186) that is significant at the 10% level (P = 0.051). This indicates that a slightly slower rate of GDP growth is associated with more access to clean cooking fuels. This counterintuitive result could be due to structural differences between the countries in the dataset or to transitional economic periods, where improvements in residential energy infrastructure do not immediately improve macroeconomic production (Suman et al., 2025). Energy Use (EU) has a positive and statistically significant coefficient (0.026, P = 0.009), which means that higher per capita energy use is linked to faster GDP growth. This aligns with the literature highlighting energy as a crucial input for industrial production and economic growth (Wang and Su, 2019). As shown in Figure 3, higher levels of per capita energy consumption are generally associated with stronger economic growth outcomes.

Conversely, inflation (Inf) has a negative coefficient (−0.133) that is significant at the 10% level (P = 0.06). This is in line with economic theory and research that shows that elevated inflation can undermine growth by eroding purchasing power and destabilizing investment environments (Christian, 2023). The Country dummy variables indicate that, in comparison to the reference category, each exhibits positive and statistically significant impacts on GDP

Table 5: OLS regression results

GDP	Coefficients	Standard error	t-value	P-value	(95% confidence interval)		Significance
AE	0.006	0.03	0.19	0.848	−0.054	0.065	
AF	−0.186	0.094	−1.98	0.051	−0.373	0.001	*
EU	0.026	0.01	2.68	0.009	0.007	0.045	***
INF	−0.133	0.07	−1.90	0.06	−0.272	0.006	*
Pak dummy	3.209	1.746	1.84	0.07	−0.263	6.68	*
Ind dummy	3.084	1.401	2.20	0.03	0.298	5.87	**
Ban dummy	6.636	2.047	3.24	0.002	2.565	10.706	***
Constant	−2.613	3.19	−0.82	0.415	−8.957	3.732	
Mean dependent var			5.134	SD dependent var			2.947
R-squared			0.291	Number of obs			92
F-test			4.169	Prob>F			0.001
Akaike crit. (AIC)			443.250	Bayesian crit. (BIC)			463.424

***P<0.01, **P<0.05, *P<0.1. OLS: Ordinary least squares, GDP: Gross domestic product, AE: Access to electricity, EU: Energy use, INF: Inflation

Figure 1: Electricity access and Gross domestic product growth in South Asia

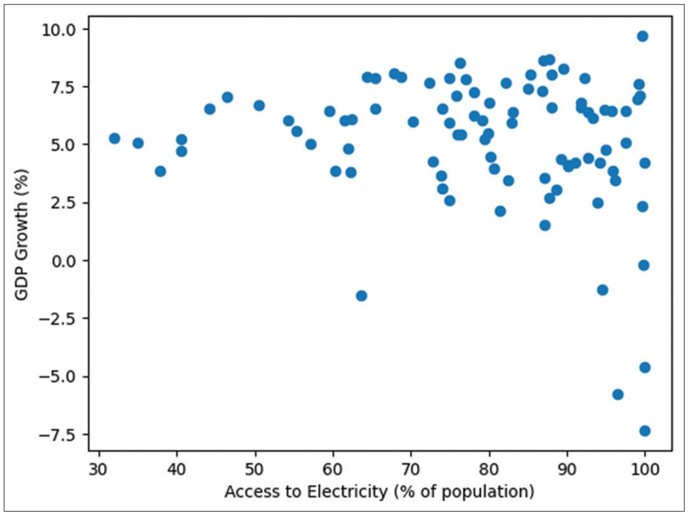


Figure 2: Estimated coefficients from ordinary least squares regression with robust standard errors

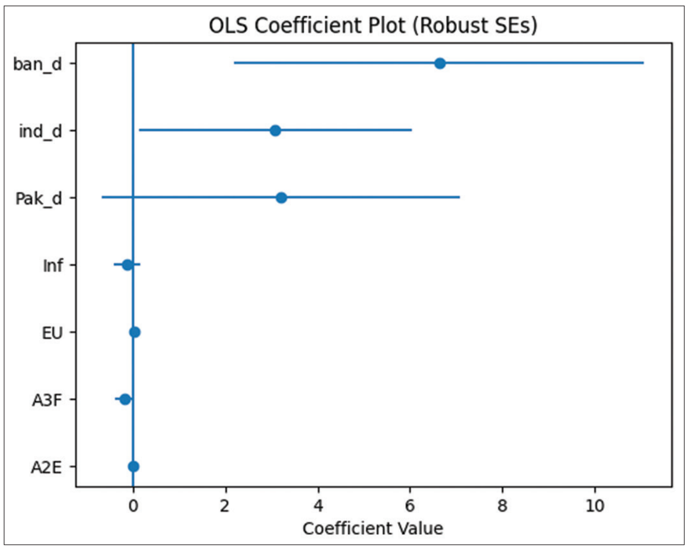
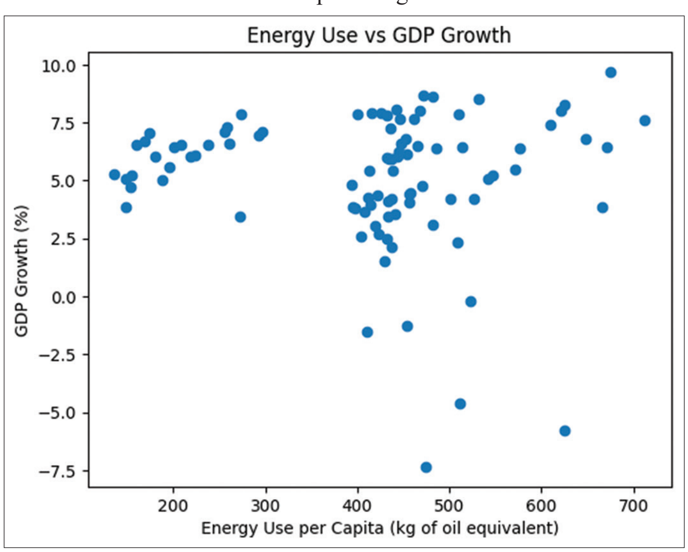


Figure 3: Relationship between per capita energy use and Gross domestic product growth



growth. The boxplot in Figure 4 highlights significant dispersion in growth performance, reinforcing the presence of structural differences across countries.

Bangladesh has the biggest and most statistically significant coefficient (6.636, P = 0.002), followed by India (3.084, P = 0.03). Pakistan's effect is positive but only marginally significant (3.209, P = 0.07). From the standpoint of energy availability, these disparities may be partially related to variation in national energy infrastructure, electrification measures, and clean cooking programs that support overall economic performance. In Consistent with Kisaka et al., 2018, the rapid electrification of rural areas in Bangladesh and the growth of off-grid renewable systems have been connected to increased productivity in industry and services. India's large-scale energy access programs, such *Saubhagya and Ujjwala*, have improved household welfare and supported economic participation (Kumar and Majid, 2020). Pakistan's lower significance might be a reflection of the country's

Figure 4: Distribution of Gross domestic product growth across South Asian countries

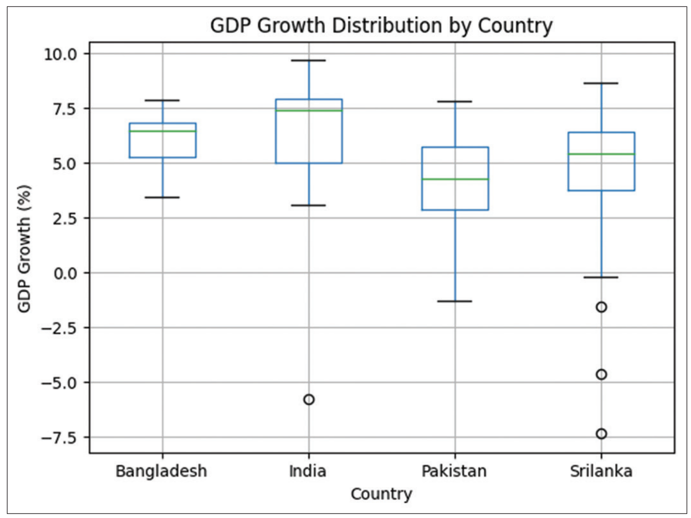
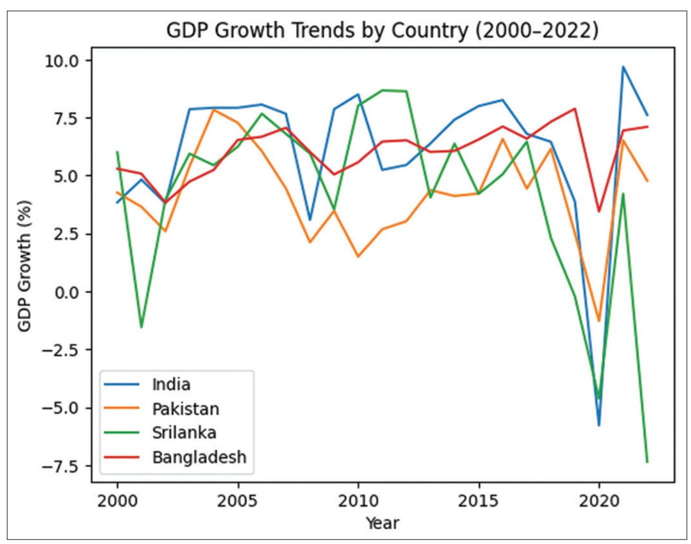


Figure 5: Gross domestic product growth trends in South Asian economies (2000-2022)



Source: World Bank, World development indicators slower progress toward universal energy access, issues with supply reliability, and the persistence of energy poverty in rural areas (Awan et al., 2022). The Study used country dummies for India, Pakistan, and Bangladesh, leaving Sri Lanka as the reference category. The constant term represents the GDP growth for Sri Lanka (the baseline country). The constant term is not statistically significant with a coefficient of (−2.613, P = 0.415). This result is consistent with Tripathi et al. (2022), which states that a significant negative impact, mostly due to Sri Lanka's 2019 economic and debt crises, led to a foreign exchange shortage, rising inflation, stalled investment, and development initiatives for energy and infrastructure. In a nutshell, all coefficients of country dummies represent deviations from Sri Lanka's average GDP growth.

6. DISCUSSION AND CONCLUSION

The paper explores the relationship between access to energy and economic growth using data of India, Pakistan, Sri Lanka, and Bangladesh over the period 2000-2022. Figure 5 illustrates substantial cross-country variation in growth trajectories, supporting the inclusion of country-specific effects in the econometric model.

The regression analysis shows that access to energy is a complicated but important factor in determining how fast economies grow in South Asian countries. Access to energy alone doesn't directly affect GDP growth; the results demonstrate that just increasing household connectivity without investing in energy efficiency, productive use, and industrial integration may not lead to broader economic benefits. This is in line with global evidence, where universal access must be accompanied by structural reform to transform them into sustainable growth (Cook, 2006). In contrast, per capita energy consumption exhibits a strong and positive association with GDP growth, reinforcing the role of energy as a critical production input. Higher energy use reflects increased industrial activity, technological adoption, and service sector expansion, which collectively drive economic performance. This result is consistent with energy-led growth hypotheses in developing economies. This aligns with real-world examples of India's Large-scale energy access programs like Saubhagya (universal electrification) and Ujjwala (clean cooking fuel), which have increased per capita energy consumption, boosting productivity and household welfare. Similarly, Bangladesh's impressive rural electrification and off-grid renewable energy programs have increased small industries and agricultural production, resulting in outstanding GDP growth.

The negative and marginal effect of clean cooking fuel access indicates that transitions toward cleaner household energy sources may not yield immediate macroeconomic gains. Instead, such transitions primarily generate social benefits, including improved health, reduced time poverty, and enhanced human capital, which materialize into economic growth over the long run rather than in short-term GDP fluctuations. Firstly, in Pakistan, efforts to get more people to use LPG and biogas have not led to more economic benefits because of ongoing energy poverty, unreliable supply, and slow industrial uptake. Secondly, Sri Lanka's economic difficulties, macroeconomic instability can jeopardize the energy access policies, which have been made worse by inflation and energy crises. Thirdly, India's Pradhan Mantri Ujjwala Yojana Scheme has reduced indoor air pollution and increased health, but its GDP effects are indirect, leading that such initiatives boost household wellbeing and long-term human capital, but their short-term economic effects may not show up in collective growth. The country dummy factors show differences in how well the economies of different countries have grown and their relation with energy access, respectively. Bangladesh had the biggest positive effect, followed by India. Pakistan had the smallest positive effect, and Sri Lanka had the negative effect. These differences are probably caused by different policies that work better in different places. For example, India's integrated energy-access plans and Bangladesh's focus on decentralized renewable energy have led to faster growth, while Pakistan's infrastructure and governance problems have slowed down progress.

The country-specific effects demonstrate that there is a lot of heterogeneity amongst South Asia. Bangladesh shows the largest growth impact which might have been due to the effective rural electrification and decentralization of renewable energy projects. The good performance of India is linked to the mass access programs of energy and the growing industrial demand. The weaker significance of Pakistan can be attributed to the problem of supply reliability and energy governance, whereas the baseline performance of Sri Lanka reflects the negative impact of the macroeconomic instability and recent crisis in the economy. In general, the results indicate that more access to energy is crucial in the economic development, but it should be accompanied by effective utilization, industrialized demand, and consistent macroeconomic policies.

The results indicate that the energy policy in South Asia must shift away the access expansion towards the productive and reliable use of energy. Governments are encouraged to invest in areas that would combine access to electricity with industry development, growth of small and medium industry (SME) and enhancement of energy efficiency. Clean cooking programs must be regarded as long term investments in human capital and not short term growth stimulators. It must have country-specific strategies. India needs to invest in more productive electricity consumption in manufacturing and MSMEs, whereas Bangladesh needs to proceed with the decentralized renewable system growth to enable rural businesses. Pakistan needs a quick change in the energy regulation, supply consistency, and costing strategies to convert access into growth. Affordability and diversification of energy sources should be considered the main objective of Sri Lanka in order to minimize the impact of shocks of foreign origin.

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