REVIEW ARTICLE

Does sustainable environmental agenda matter in the era of globalization? The relationship among financial development, energy consumption, and sustainable environmental-economic growth

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Abstract

The purpose of this research is to explore the connection of financial development, sustainable environmental-economic growth, and energy consumption among the South Asian Nations. This research examines a combine influence on energy consumption, financial development on sustainable environmental economic growth regarding south Asian economies. This study has used autoregressive distributive lag (ARDL) and panel data set from World Development Indicators (WDI) start from 1980 to 2018. The findings of this study indicate a significant and positive effect of financial development toward economic growth of selected south Asian economies. However, energy consumption has also positive impact toward sustainable environmental-economic growth, which further leads toward sustainable environmental agenda progress. Finally, energy consumption results have positive effect on sustainable economic growth among mean group (MG), pooled mean group (PMG), and common correlated effect mean group (CMEMG) results.

Keywords Financial development · Energy consumption · Sustainable environmental economic growth · South Asian countries · ARDL

JEL Classifications E11 · E14

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Introduction

The second stream of EKC literature investigates the impact of economic growth on power usage, using cointegration and causality analyses, in connection with Kraft and Kraft's (1978) study, which is also in connection with another empirical study that found "energy usage" to be one of the determinant factors of "environmental degradation" (Yuan et al. 2007). To tackle the exclusion of "variable bias" in the research, the third aspect integrated the two main dimensions in the studies on EKC with the addition of "energy usage" as well as other economic factors for some more research of the EKC theory (Anatasia 2015; Cetin et al. 2018; Heidari et al. 2015; Koçak 2014; Katircioglu 2017; Katircioglu et al. 2017; Yavuz 2014). Nevertheless, due to differing results from numerous researches from various regions, there has been no consensus on the "EKC theory." As a result, it is critical to think about "country-specific" signifiers when doing research. In light of the above discussion, it is vital to investigate the nexus between financial development, energy consumption, and long-term environmental-economic growth in order to protect the environment. The significance of carbon dioxide discharges as an incredible supporter of ozone harming substance, i.e., GHG (greenhouse gas), was illustrated by the IPCC (Intergovernmental Panel on Climate Change), which revealed that about 76.60% of "GHG discharges," which include CO_2 emissions, come from developing nations with the goal of accelerating their national product and growth rate to accomplish favorable economic conditions (Gökmenoğlu and Taspinar 2016; Cioca et al. 2015; Wang et al. 2014) enhanced economic growth, as per Kirikkaleli and Kalmaz (2020), raises quality of life, except it likewise prompts urbanization increment and energy utilization, both of which contribute to high CO_2 discharges. This could be the aftereffect of misallocation or abuse of energy assets that is frequent transcendent in developing countries (Zhao et al. 2018). Three strands were prominently recognized in the investigations that focus on this discussion. Right off the bat, the legitimacy of Environmental Kuznets Curve (EKC) hypothesis was researched by looking at the impact of economic expansion on fossil fuel byproducts, i.e., carbon discharges (Dinda and Coondoo 2006; Grossman and Krueger 1995; Lee and Lee 2009).

.The environmental protection agencies also propose more significant usage of renewable energy resources to offset the rate of climate change (Sadiq et al. (2021), Yikun et al. (2021), Nawaz et al. (2021a)), Anser et al. (2021a)), Jalil 2014). The usage of renewable energy resources helped to improve the health of the general public and decreases the rate of air pollutants, supporting economic development and generating employment opportunities (Liu et al. 2021). More

energy requirement is expected due to urbanization, and it increases the production of energy and size of the market over the last few years. As compared to rural life, more energy consumption is required for urban life, which is due to transportation, infrastructure development, sanitation, and construction of dams, bridges, roads, and houses. Almost all south Asian countries have launched different short and long-term economic plans and liberalization their economies in order to make upsurge their growth level. However, Pakistan is also one of them, who introduced nationalization program after Bangladesh partition in 1971. Furthermore, Pakistan and Bangladesh have made liberalization their economy in 1990 and India prepared it in 1991 to attain the certain economic objectives. The liberalization restrained subsidized to reduce policy-induced anti-export bias at a modest level Shabbir (2020). Chen et al. (2017) examined the impact of foreign investment on economic growth of China from time period from 1994Q to 2014Q. The statistics related to FDI inflow and entry mode was obtained from the Ministry of Commerce. The data related to GDP and Gross Fixed Capital Formation was taken from the CEIC database. In addition, data on nominal lending and export volume was obtained from the IMF.

The Indian economy has been a new center of attraction over time because of its growth potential and impact on the global economy. This region has a potential to improve productivity, financial performance, sustainable environment, and economic growth and to become the fast-growing region in the world economy given the government policies are supportive. Hence, the current study aims to identify the inter-linkages among financial development, energy consumption, and economic growth for the region of South Asia. This study is going to examine the relationship among financial development, energy consumption, and economic growth from south Asian region. However, this study identifies which particular region has a significant contribution toward the rapid economic growth level and upsurge through financial development and energy consumption. This study measures several panel causality tests in order to give exact relative picture for growth level among these countries (Fig. 1).

Nexus among economic growth (GDP per capita), financial development, and energy consumption

The economy started as the rural one but transition to manufacturing and service sector took place[1]. The increase in the income has reduced the "National poverty headcount ratio" to 4.1% in 2016 from 15.3% in 2006/07. However, an increased the chances of prosperity for the country. India has also experienced an increase

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[1] https://www.worldbank.org

Fig. 1 South Asian economies' real GDP per capita. Source: World Bank data
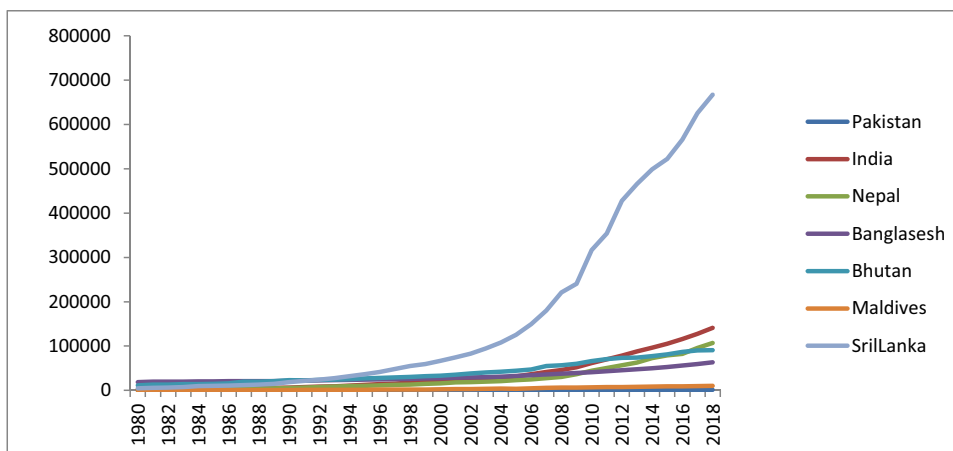
the income after 2004 onwards. The development of the manufacturing and service sector along with the investment in information technology has increased the chances of sustainable economic growth many folds; whereas, for other countries of South Asia, improvisation is seen over the period of time.

Figure 2 shows an improvisation of the financial institutions that can lead to the better supply of financial services in a least costly way which can lead to sustainability of revenues and management of the level of transactions in the capital markets (IMF, 2016). In the 1980s, the financial markets were regulated in India and more openness was experienced by India and could not improve much but later liberalization and the deepening of the financial activities enhanced the financial openness in India (IMF, 2017).

Figure 3 shows the trade as a percentage of GDP of the South Asian Economies. The highest level of trade is experienced by Maldives. The fishery sector, food industry, and a small proportion of export of iron, steel, and cooper are adding up to the energy revenue for the country.

Literature review

Several terms have been used in literature for financial sustainability such as financial longevity, long-term financial performance, financial health, etc. (Imhanzenobe 2020). The idea of financial sustainability is often assumed to have a converse link with financial distress. Usually, the dynamics that support financial sustainability go about as drivers of its inverse (i.e., financial distress) (Gardini and Grossi 2018). Moreover, when the poor financial or operational performance is concealed through EM, it encumbers management to early diagnosing and fixing the issue, due to which the firm becomes impotent to endure the competitive environment's setting (Agustia et al. 2020). Thus, we can say that earnings management halts financial sustainability and becomes a reason for the financial distress situation of a business.

Ndikumana (2000) provided the support that financial development is significantly affected by the private investment in Sub-Saharan countries. Results reveal negative

Fig. 2 Graphical presentation of financial development. Source: World Bank data
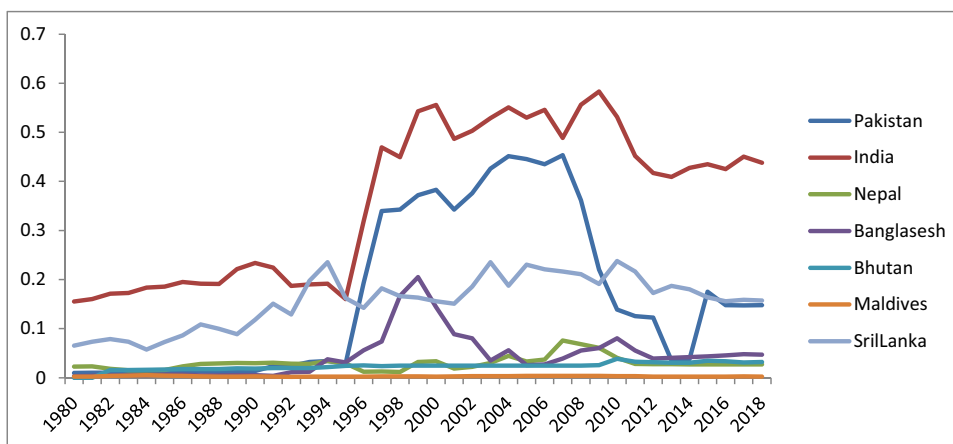
Fig. 3 Energy consumption in South Asia. Source: World Bank data
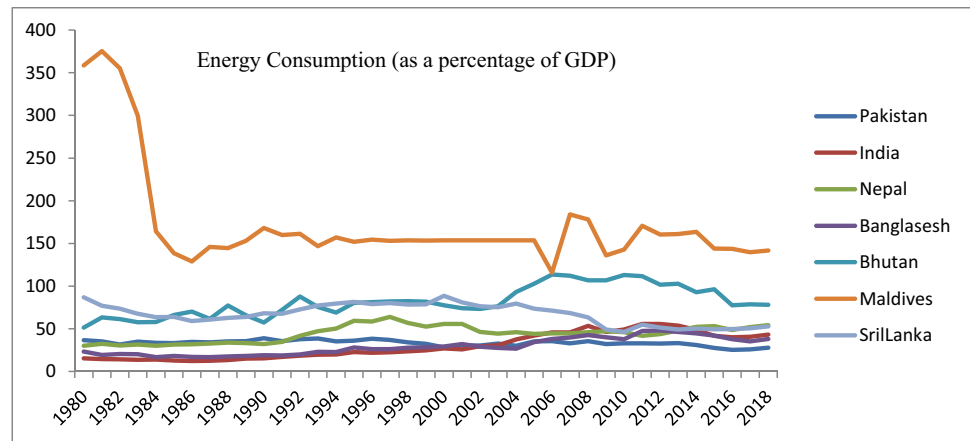
effects of external debt, black market premier, inflation, and domestic borrowing of government on domestic investment specifically for investment purposes would positively affect the long-run economic growth. The study suggests a balanced expansion of financial systems, policies with fewer costs of financial intermediation, supportive environment for lending to investment purposes as significant contributors to domestic investment and financial development. Menyah et al. (2014) used proxies for the economic growth (RY) and TO (Trade openness) are real GDP per capita and [(export + import)/GDP × 100%] respectively. The finance-led growth and trade-led growth hypothesis are not supported by the results for these 21 SSA countries.

Perera and Wickramanayake (2012) scrutinized the integration of financial market, trade openness, and sound investment climate to attract FDI specifically for Africa, South Asia, and Middle East countries. The study also highlighted the stronger impact of these two determinants of FDI. Shabbir (2018b) suggests developing countries to initiate and enlarge their efforts for trade volumes. Baloch et al. (2020b) studied the causal relationship between the environmental degradation as ecological footprints and poverty for 46 Sub-Saharan economies for the period of 2010-2016. The study finds a causal relationship that exists between the variables. A reduction in poverty occurs when the economic growth and availability of the electricity increases but it leads to the degradation of the ecological footprints. Baloch et al. (2019, 2020c) examine the relationship between carbon dioxide emissions (CO_2), poverty, and income inequality over the time period, i.e., 2010–2016 for forty Sub-Saharan countries. The results suggest that CO_2 emission increases when income inequality is more and the environmental degradation increases with the increase in poverty.

Clemente et al. (2017) examined growth and the energy usage association by using the method of structural breaks to identify the effects of energy prices fluctuations, business cycles, and fluctuations in local government and global energy policies. Furthermore, various researchers also criticized the method of structural change than the method of "quantile-on-quantile" is employed to identify the entire changes in the relationship between energy-growth. Shahzad et al. (2017) discussed the importance that it captures the effects of distribution-to distribution significantly. The same results are obtained by few more researches, i.e., Fase and Abma (2003), Shabbir et al. (2020), Nawaz et al. (2021), Saleem et al. (2021), Anser et al. (2021), Mughal et al. (2021), Arslan et al. (2021), Jun et al. (2021), and Christopoulos and Tsionas (2004). A strong support exists for the King and Levine (1993a, 1993b) and Smarzynska Javorcik (2004) contention stating "financial depth contributes more to the causal relationships in developing countries." The findings underline a strong association between financial intermediation to endorse growth rate, specifically for nine economics of the selected developing countries. Anwar and Sun (2011) have developed a theory regarding financial institution-based development and used simultaneous equation-based structural model for empirical measurement.

The moderating influence of "financial development" is indeed one of the unaddressed questions in the existing literature on the factors influencing carbon emissions. This is necessary due to the link between environmental degradation and carbon emissions, which is regarded one of the most significant barriers to long-term sustainable growth. Therefore, Rjoub et al. (2021) looked into the effect of financial development on the drivers of carbon emissions in Turkey from 1960 to 2016. The Bayer–Hanck cointegration and ARDL bounds check were used to look into the cointegration of the variables used. The research analysis demonstrates that financial development, urbanization, energy consumption, capital formation, and economic growth as a driver for environmental change. the study discovered that "financial development" has a substantial moderating influence. Environmental–financial strategies have been proposed

for Turkish policymakers to aid in the depletion of carbon emissions along with the goal of enhancing environmental quality.

Theoretical framework

It is noted that Kraft and Kraft (1978) are the first to mention the energy-led growth nexus in their paper. Many scholars are still looking on this problem to this day. Although several economists have proposed many theories of economic growth and development, these ideas ignore energy as a vital component of economic growth. In the Solow model of growth, technical innovation is regarded as a key component of economic expansion. The AK model discusses how higher levels of saving might boost economic development. In the Schumpeter growth model, innovation and capital formation are seen as the most essential factors of economic growth.

The "supply leading" concept states that a vital factor regarding economic growth. Alternatively "demand following" concept emphasizes that financial development can be enhanced by the economic growth. Solely the development in the financial sector does not have the potential to lead an economy as it is merely a byproduct of the economic growth (Robinson 1952). Financial sector will grow resulting in more institutions, products and services, and financial market is an indication of less demand of financial products in a country. Financial liberation in countries like China and Japan is not the leading factor of growth and Asian economic crises create doubt about the strengths of financial system to be leading factor in economic growth (Shan 2005; Shabbir 2018a).

Equation (1) shows association among energy consumption (EC), financial development (FD), and economic growth (EG)

$$EG_{i,t} = \beta_o + \beta_1 FD_{i,t} + \beta_2 EC_{i,t} + \varepsilon_{it} \tag{1}$$

Methodology

The panel data is used and taken from World Development Indicators (WDI) for the analysis. The countries under this study are Bangladesh, Bhutan, India, Maldives, Pakistan, and Sri Lanka. The economic growth (EG) is taken as real GDP per capita, and energy consumption (EC) is used as energy use (Kg of oil equivalent per capita). In addition, an Index of financial development (FD) is developed as a proxy of financial development. Many variables can be considered at a time to capture the essence of financial development and inter-linkages between the financial products can create multicollinearity. Hence, formation of an index appears to be viable step here so as to avoid the loss of information in the model. The variables used in the construction of index by using principle component and adopted autoregressive models (Pesaran et al. 1999). The issue of endogeneity can also be tackled in this way if direction of causality is from economic growth to financial development. This study adopted the auto regressors distributed lags (ARDL) approach, which has developed by Pearson (1997), and Pearson and Shin (2001) respectively.

ARDL model in our study is as under:

$$EG_{i,t} = \eta_i + \sum_{j=1}^{p} \lambda_{i,j} E_{i,t-j} + \sum_{j=0}^{q} \gamma_{i,j} Z_{i,t-j} + \varepsilon_{it} \tag{2}$$

whereas *EG* is the proportion of GDP at time *t* and in i^{th} group. The fixed effect in data is captured by η_i and vector of explanatory variables, i.e., financial index and trade openness is shown by $Z_{i,\,t-j}$. The first difference of Equation (2) can be rewritten as:

$$\Delta EG_{i,t} = \eta_i + \tau_i E_{i,t-i} + \sigma_i Z_{i,t} + \sum_{j=1}^{p-1} \lambda*_{i,j} \Delta E_{i,t-j} + \sum_{j=0}^{q-1} \gamma*_{i,j} Z_{i,t-j} + \varepsilon_{it} \tag{3}$$

whereas $\tau_i = -\left(1 - \sum_{j=1}^{p} \lambda_{i,j}\right)$, $\sigma_i = -\sum_{j=0}^{q} \gamma_{i,j} \lambda*_{i,j} = -\sum_{m=j+1}^{p} \lambda_{i,m}$ and $\gamma*_{i,j} = \sum_{m=j+1}^{q-1} \gamma_{i,j}$ with $j=1, 2, 3, 4, 5, ..., p-1$.

When the variables are grouped by level, we get Equation (4):

$$\Delta EG_{i,t} = \eta_{ii} + \tau_i \left[E_{i,t-i} - \theta_i Z_{i,t}\right] + \sum_{j=1}^{p-1} \lambda*_{i,j} \Delta E_{i,t-j} + \sum_{j=0}^{q-1} \gamma*_{i,j} Z_{i,t-j} + \varepsilon_{it} \tag{4}$$

whereas long-run elasticities are exploring by $\pi_i = \frac{\sigma_i}{\tau_i}$ and the speed of adjustment to reach long-run equilibrium is represented by τ_i.

$$S' = \sum_{i=1}^{n} \left(\beta_i - \tilde{\beta}_w\right) \frac{x_i' M - X_i^2}{\pi^2} \left(\beta_i - \tilde{\beta}_w\right) \tag{5}$$

While Pooled Ordinary Least Square estimates are given by β_i, weighted fixed effect estimators are given by $\tilde{\beta}_w$, identity matrix is defined as M and asymptotic normal distribution is followed by the test.

Pesaran and Smith (1995) indicated the more relevant assumption of our analysis where the economic growth is explained through financial development and trade openness. Most countries experience the long-run growth path at a constant rate due to technological transfer as explained by Hall and Jones (1999) (also see Parente and Prescott 1994; Shabbir et al. (2020) and Eaton and Kortum 1996) hence the use of MG and PMG and can be justified in this study and it would enable us to find the varying interceptions.

The null hypothesis states that no cross-sectional dependence exists and is mentioned in Equation (6).

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho} \right)_{\rightarrow} N(0,1) \right) \quad (6)$$

While estimate of the residuals' correlation coefficient is presented as $\hat{\rho}ij$ that can be further expanded as:

$$\hat{\rho}ij = \hat{\rho}ij = \frac{\sum_{t}^{T} \hat{\mu}_{it} \hat{\mu}_{ij}}{\left(\sum_{t=1}^{T} \hat{\mu}_{it} \right)^{0.5} \left(\sum_{t=1}^{T} \hat{\mu}_{jt} \right)^{0.5}} \quad (7)$$

Maddala and Wu's (1999) first-generation model presupposes cross-sectional independence, Arif and Shabbir 2019; Im et al. 2003; and Levin et al., 2002. In contrast, second-generation models, such as Saleem et al. (2019b); Shabbir (2016); Nguyen et al. (2020); Pesaran (2007); and Bai and Ng's (2004).

Next, this study runs the test for cointegration to identify the existence of the long-run relationship between the concerned variables. The test proposed by Westerlund (2007) is applied in this study which has four measures that is Panel tests, such as Pt and Pa, are used to assess different hypotheses of cointegration, which states that minimum of one element of the panel, will have a pattern of cointegration. Afterwards, the short and long-term coefficients are estimated by using PMG, MG, and CCEMG frameworks.

Results and discussions

Pesaran (2004) and Muhammad et al. (2020) test would be more reliable in this case (Tables 1, 2, 3, 4 and 5).

The importance of this result lies in the theoretical consideration that if methodology of pooled lease square or generalized method of moment is used to generate long-run coefficients through panel autoregressive or error correction model then results would not be reliable as heterogeneity exists in our model Saleem et al. (2020). The

Table 1 Results of Panel unit root test. H0=series is I(1)

	Lag 0	Lag 1	Lag 2
(A) Maddala and Wu panel unit test			
EG	0.935	0.94	0.42
FD	0.447	0.758	0.675
EC	0.243	0.110	0.004
(B) Pesaran Panel Unit Root test (CIPS)			
EG	0.725	0.33	0.086
FD	0.003	0.343	0.843
EC	0.093	0.166	0.102

Table 2 Slope heterogeneity and cross-sectional dependence analysis

	χ^2	p-value
(A) Analysis for cross-sectional dependence LM Breush Pagan test	126.15	<0.001
Pesaran test	16.96	<0.001
(B) Analysis for slope heterogeneity		
Adjusted Swamy statistics	55.84	<0.001

Table 3 Westerlund EC panel cointegration tests

H0: no cointegration

	Value	p-value
Gt	−4.702	0.038
Ga	−2.618	0.931
Pt	−4.275	0.031
Pa	−3.289	0.053

Table 4 Panel causality analysis for financial development, economic growth, and trade

Regressors	Sources of causation			
	SR			LR
	ΔEG	ΔFD	ΔEC	ECT
ΔEG	NA	0.0403**	0.0431)	−0.014*
	NA	(0.013)	(0.053)	0.003
ΔFD	0.9266**	NA	0.523	−0.086***
	(0.423)	NA	(0.326)	0.047
ΔEC	0.076	0.067***	NA	−0.064***
	(0.263)	(0.045)	NA	(0.036)

Level of significance: *=1%, **=5%, and ***=10%

Table 5 Long term impact of energy consumption and financial development on South Asia's economic growth

Regressors	PMG	MG	CCEMG
FD	0.18**	0.22	0.08**
	(0.05)	(0.15)	(0.02)
EC	0.25*	0.66**	0.14
	(0.03)	(0.29)	(0.18)
Hausman test	0.393		

Standard error in parenthesis

Level of significance: *=1% and **=5%

Table 6 Short-run Country's dynamic

Country	ΔFD	ΔEC	ECM	Diagnostic tests			
				SC	FF	NOR	HET
Bangladesh	0.023***	0.092**	−0.023**	0.15	0.13	0.82	0.21
Bhutan	0.006	0.086***	−0.016***	0.80	0.54	0.62	0.65
India	0.086*	0.074***	−0.032*	0.53	0.47	0.74	0.34
Maldives	0.054*	0.202**	−0.023**	0.52	0.13	0.21	0.19
Nepal	0.017	0.233**	−0.003***	0.16	0.67	0.94	0.22
Pakistan	0.092*	0.086	−0.016***	0.24	0.27	0.42	0.24
Sri Lanka	0.024***	−0.142**	−0.006***	0.27	0.41	0.55	0.45

Level of significance: *=1%, **=5%, and ***=10%

Diagnostic test: Het, heterogeneity; NOR, normality; FF, functional form; SC, serial correlation

model specification is also important to be tested in case of slope heterogeneity as the results can be altered by it. Therefore, functional form is tested (see Table 6) under the null hypothesis stating correct specification of functional form. The p-values show that H$_0$ is accepted and model is correctly specified.

The results of Gt, Pt, and Pa indicate that relationship exists among the variables in the long run.

The next step is to find the casual relationship between the variables as cointegration test tells us the existence of relationship only. The granger causality is determined by using estimates of PMG model (Jalil 2014) and Equation (4) is adopted to examine the error correction model. In addition, two more equations are estimated by taking financial development. The panel causality test indicates the two-way causality among the financial development and economic growth. When the economic activity is accelerated, it also accelerates the demand for the financial instruments which provides a pathway for the development of financial sector for the region regarding South Asia over the period of years.

The methodologies of PMG, MG, and CCEMG are used for the estimation and results show in Table 5. Financial development affects the economic growth positively and it is significant in case of PMG and CCEMG model. The financial services and products increase the margin for the countries to explore more forum and development of economic activities. The growing financial markets encourage flow of the fund, attract more foreign investors, and build up the confidence of the local investor in the country. Our results differ from Shan (2005) that explains Asian economic crises create doubt about the strengths of financial system to be leading factor in economic growth.

The energy consumption also creates a positive influence on the growth of an economy and affect is significant for MG and PMG estimates. The energy consumption helps the domestic producers to focus on the production methods that cost effective and leads to better quality of the product. The spatial influence of the South Asian economies has increased with the passage of time. India has experienced an increase

in the export of the processed petroleum, pharmaceutical, and precious stones from 2002 onwards and Bangladesh and Sri Lanka have improved the trade potential in textile and garments. Hence trade generates the stream of income for region.

The PMG model lies on the fact that it allows for slope heterogeneity in short run. The outcomes are presented in Table 6. Moreover, the time series data is estimated for each country also so analyze the short-term effects.

The results suggest that directly proportional and significant impact of financial development exist among selected south Asian countries. Pakistan has faced the energy shortages in the previous years which have created the hindrance in the production processes. It has lost its position as one of the major exporter of the textile items over time as the competition has emerged within the region and Bangladesh and Sri Lanka have experienced more demand of textile export in the recent times. However, normality prevails in the distribution of residuals and heteroscadascity does not exist. Hence, impact on economic growth determined in the model can provide important policy implication due to stable estimators found in this study.

Conclusion

The model purposes to determine the association between financial development, economic growth, and energy consumption among south Asian economies. We obtain some more substantial results that the routes of financial development which improvise energy consumption should be channeled carefully in case of financial reforms so the real sector growth can be enhanced and further economic growth is ensured. The energy consumption also plays an important role in the development of countries in the South Asia. The South Asian economies have flourished the hypothesis of trade-led growth is supported in long run by our study. The trade policies should be focused on improvement in exports in term of nature and value of

commodity. Alongside the country-specific factors, cross-sectional dependence in the region should be considered by policy makers. We have learned from the study that the economic growth of a country can be affected by growth of other countries. This study provides the opportunity for further studies to explore the impact of development of different types of financial markets in South Asia over time in the current study context.

This study can also be replicated for region-based analysis for other regions of the world. This study suggests several policy implications to the government of South Asian countries that include; (i) advancement and active promotion of equity of joint venture (EJV) to upgrade the industry in the south Asian region, (ii) preferential treatment and fiscal concession for foreign investors should be very selective, (iii) provision of financial and non-financial support from government, (iv) refocus on a domestic-led economy rather than an export-driven one. However, our study has some limitations as well; first, the present study has taken the non-financial sector into account. The same research can also be carried out on the financial sector to see the control mechanisms regarding other variables Therefore, more studies can be carried out in different regions for enhancing the interesting understanding of financial development sector on the link between energy consumption and financial sustainability in different settings.

Availability of data and materials The data is available on request from corresponding author.

Author contribution Dr XingHua Cao has completed the data analysis part, Dr. Desti completed the Introduction section, Dr Ye completed the Literature review section, Miss Kanwal wrote Methodology section, Mr Malik Shabbir interpreted the data analysis section, Dr Jamal wrote conclusion and Dr. Mosab wrote abstract parts and format the paper as per journal requirements.

Declarations

Ethics approval and consent to participate This study did not use any kind of human participants or human data, which require any kind of approval.

Consent for publication Our study did not use any kind of Individual data such as video, images etc.

Competing interests The authors declare no competing interests.

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