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The validation of Granger causality through formulation and use of finance-growth-energy indexes

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ABSTRACT

The paper aims to investigate the finance-growth-energy nexus validity in Pakistan by taking large range of relevant variables and developing indexes. Focus of the paper is to evaluate the long run relationship between financial development, economic development and energy consumption. After extracting the indices, Granger's Ordinary Least Squares (OLS) regression and correlation is used to explain short run deviation in the nexus. In order to capture co-integration, Eagle Granger approach is applied, lastly Hurst exponent are used to estimate annual rescaled range statistics to explain deviation during period of analysis. Granger causality has been empirically tested in a robust way incorporating large range of relevant variables on overall nexus of finance-growth-energy that has been hardly tested in such depth. Index formation through econometric analysis is novel part of this study, which revealed that in short run Financial Development Index (FDI), and energy price have significant relationship with energy consumption. However, in long run analysis has endorsed the concept of granger casualty, especially on feedback hypothesis. Study has practical and theoretical contribution to the literature that could be highly beneficial to policy makers.

1. Introduction

Striding for stable economic development and spreading out the outcome of efficacious economic policy revolves around highly debated nexus of Financial, Economical and Energy Stability. In case of advanced countries, growth rates tend to be highly stable over long periods, provided these are averaged over long periods to exclude business-cycle effects or corrected for short-term fluctuations using other techniques. However, in case of developing countries, many examples of sudden, large changes in growth rates both up and down have been recorded in the history [1]. A number of factors have been reported in the publications that influence a country's financial and economic growth [2,3].

Energy sector serves as the mainstay of manufacturing and service sector of any economy, henceforth growth process is apparently energy sensitive [4–7]. Energy usage is universally recognized as requisite factor for production [8–10]. A detailed study published 1988 on End Use Global Energy Project (EUGEP) anticipated global energy scenario for 2020 and envisioned a widespread shift in the developing world from traditional fuels to new energy technologies; thus even with population raise to 7 billion the energy requirement would rise only by 10% [11]. Discussion on the nexus initiated by seminal work of Kraft and Kraft where they explored the causal relationship between growth and energy for the very first time [12]. Later, other researchers recognized that directions of causal effect between growth and energy is substantial for making valid policies [13–15]. Another researcher published her efforts to highlight the causality between energy usage and economic growth [16]. The study braced the fact like many others that energy expansion leads to higher growth while its shortage retards the process [17].

Thus, literature on causality cast around two school of thoughts one with the view that energy usage leads to increase or decrease in the economic growth known as Energy led growth hypothesis, others are in the view that massive advancements in economics growth will lead to significant energy consumption known as Growth-led energy hypothesis [17–19]. Causality between growth and energy is also known as Granger Causality in literature, associated after Granger's publication [20]. Growth of the literature led to four cases of Granger Causality that are Unidirectional Energy-to-growth effect (Growth Hypothesis) [21]; Unidirectional Growth-to-energy (Conservation Hypothesis) [22]; Bidirectional (Feedback Hypothesis) [23] and No Causality between growth and energy (Neutrality Hypothesis) [24]. Researchers have

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preferred Granger's causality test to other available theories due to inherent profound empirical testability [25–28]. Despite the availability of extensive literature on Granger Causality, results are indecisive. Therefore, researchers deliberated that vague relationship between variable in question can only be validated by empirical analysis [29].

Nexus of energy and economic growth reveals bidirectional causality taking Gross National Product (GNP) as indicator in Iran [30]. Furthermore, application of "Sim-Granger Test" for vast range of countries produced mixed results, thus Germany, India and Indonesia showed unidirectional causality by different researchers [31], another study reported a strong evidence for unidirectional causality running from the electricity consumption to the income for Turkey [32]. While Italy, Japan, England, France and Canada conform to case of bidirectional causality [33]. In the same context, Gulf countries have shown causal effect from growth to energy consumption [34], whereas, Wietze and Monfort unfolded the linkage between energy consumption and Gross Domestic Product (GDP) by undertaking a co-integration analysis for Turkey [35]. On the other hand Paul & Bhattacharya published that Growth Hypothesis holds true for India [36], Riaz and Stern stated that Neutrality Hypothesis is prevalent for the case of energy consumption and economic growth in Pakistan [37] and Batliwala and Reddy revealed that demand for energy consumptions depends on the per capita energy usage in economy [38].

Focusing on the most recent research on economic development and energy consumptions nexus, revealed that there exists a significant relationship thus it could be anticipated that significant relationship also prevails between financial development and energy consumption [39–42]. Thus, financial development can have impact on energy consumption in three ways i.e., direct effect; business effect and wealth effect, collectively known as effect channels of finance-energy nexus [43]. Granger Causality between financial development and energy consumptions depicts unidirectional approach through energy consumption [44] and in contradiction long run relation has been found in finance-growth-energy nexus [45].

The authors aim at investigating cases of granger causality in Pakistan, using the nexus between financial development, economic development and energy consumption. Theoretical and empirical contribution is a novelty of the study, as nexus between finance-growth-energy through index formations by large range of influencing variables has not been tackled in this detail by other researchers. Principal Component Analysis (PCA)[1] is used to develop financial and economic development indexes for rigors econometric analysis. This study will contribute to the existing literature by applying various econometric models. Testing the long run neutrality/equilibrium Eagle Granger co-integration has been discussed and in order to enhance the explanatory power of research, Granger OLS approach is used for short-term relations between finance-energy-growth nexus. Finally, Hurst exponent analysis[2] is applied for computing the rescaled range statics of each data series, being highly beneficial for policymakers to see lag trends in each variable.

This paper based on the study is organized as follows; "Energy Sector in Pakistan" section represents the brief background of energy sector in Pakistan. Next section of the paper provides the literature view in a global perspective with respect to the subject. A section titled "Data and Methodology" comprises the details of methods used for analysis of acquired data from different sources. Towards end of the paper, a separate section elaborates empirical results generated by employed models, while the last section concludes the study.

2. Energy sector in Pakistan

Pakistan has signed koyto Protocol[3] under "United Nations Framework Convention on Climate Change (UNFCCC)" in 1997 and implemented it in 2005. Complying with conditions of Kyoto Protocol turned out to be challenging for developing countries where economic development is on fast pace and energy consumption is increasing rapidly. Global energy consumptions expected to grow by 56% during the period of 2010–2040, and it's expected that majority of demand would come from the developing countries as they are in process of expansion [46].

Pakistan is passing through its worse energy crisis phase since past decade, energy consumption is expected to double in one decade [47–50]. Structure of energy sector has been modified in last few decades, as before 1980 government was sole producer and distributor of energy, generated by all sources [51]. Furthermore, energy sector of Pakistan has never delivered, what it is committed to, reason being poor management, insufficient capital, lack of interest in improving the situation and lastly political influence on picking up of suitable projects [52–55]. Choice of source of power generation is another major loophole in power sector, heavy reliance on oil and coal projects, neglecting wind and thermal projects [56–60], despite obvious devastations of flood government is not interested in making water dams on urgent basis, monopoly of independent power producers IPPs is another sound reason [61]. Flimsy economic conditions of Independent Power Producers (IPPs) as they lag in payment of their debts to oil industry, bucketing up circular debt, shift to gas consumption and insufficiency of gas resources, less utilization of hydel power and minimum reliance on atomic energy can explain the scarcity of energy in Pakistan [62–67].

According to Government of Pakistan [115] high system losses are another agent for poor energy mechanism, distribution and transmission losses are around 20%. Lack of electricity would cause an estimated loss of 2.6 billion dollar annually with direct hit on unemployment [68]. Net growth rate of energy supply was reported to be 1.8% and growth rate of energy demand yields out to be 2.9% [116]. During the 5-year phase of 1994–1999, power generation capacity was 53%, which fell to 12% until the end of 2007. The scenario made Pakistan vulnerable to energy crisis [69,70], because rapid economic and financial development is to be backed by immediate initiation and quick working of new power projects [71]. Although, restructuring of energy sector has generated a hope and resulted in some commercialization and Privatization [72].

Policy makers should pay attention to the issue that area wise electricity coverage has not reached 100% and if the government intends public involvement in economic and financial development, an emergency declaration in this sector needs to be implemented [73–75]. As it provides the clear glimpse of current and expected electricity demand-supply shortfall for Pakistan. Although, government has initiated many small-scale power generation projects with the assistance of foreign investors, but in the light of expected growth in electricity demand these measures are considered insufficient.

3. Financial development and energy consumption

Financial development is interlinked with economic progress of the country, when domestic and business sector get easy finance for business activity enhancement need for energy usage ostensibly boosts up. Financial development follows three stage process as mentioned earlier i.e., business effect; direct effect and wealth effect. Moving along the quantum economies also progress and become efficient, thus stable stock markets act as the proxy of economy. Well established stock

[1] Principal Component Analysis (PCA) is a procedure of finding the liner combinations with maximum variance and removing their effect with many iterations.

[2] Hurst Exponent measures the long run memory, by explaining the autocorrelation and their rate of decrease by change in lag terms.

[3] Kyoto Protocol is agreement that endorse the climate sustainably and signatories have to omit co2 omissions for healthy climate.