Research Proposal

Title: Geopolitical Risk and Energy Trilemma in Developing Countries: An Application of Spatial Econometric Analysis

Authors:

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1. Research Problem

Over the past decade, the remarkable economic growth of the developing economies has been closely tied to its unprecedented growth in energy consumption. Despite progress towards SDG-7 of many developing countries, coordination failures among key stake holder (e.g., governments, corporations, and civil society) along with the geopolitical risks (Russia-Ukraine war) has left significant impacts on the consumption patterns of energy, created an energy trilemma of conflicting energy security, affordability and environmental sustainability (World Energy Council, 2024). Energy trade-offs due to geopolitical shocks among energy security and affordability, accessibility and sustainability has created a challenge specially for developing world. Due to which, the low- and middle-income developing countries have stepped up to import more non-renewables to meet the shortfall, managing to ease the stress on energy security. However, to address these security dimensions in the short run, there arise significant repercussions to energy equity, ultimately pose a threat to environmental sustainability. To fix this puzzle of trade-offs, as suggested by World Energy Counsel 2024 a dynamic resilience framework along with a humanizing approach is required. Under the umbrella of dynamic resilience framework, green innovations and artificial intelligence can serve as a catalyst, the targets can be achieved, and a relevant policy can be designed.

2. Policy Context

This research would help the policy sector of developing countries in the following ways.

Firstly, developing economies will rethink adopting a more resilient and spatial dynamic framework to absorb the spillover impact of geopolitical risks, as well as their mitigation capabilities. Meanwhile, the stakeholder's cooperation in the region will be strengthened to mutually create a stable and peaceful environment, which is key for sustainable green energy consumption. Secondly, exploring spatial dependence among security, equity and sustainability of energy can lead to harmonized regional energy policies and effective resource allocation. The findings can help those economies which are lagging on the path of convergence towards sustainable energies consumption and fail to reach their golden steady state. Moreover, the spatial convergence of sustainable green energy is important for energy security and equity through greens innovation. Third, the study results will employ if there is heterogenous speed of convergence of sustainability among economies and what is the impact of geopolitical factors on the rate of convergence. The study will help the developing economies to formulate appropriate environmental to achieve sustainable economic growth.

3. Objectives: Identify overall study goals and specific research objectives

The key objectives of this study are.

- To explore the spatial dependence in security, equity and sustainability in developing countries of the globe.
- To test the presence of spatial β-convergence and spatial σ-convergence in security, equity and sustainability in developing countries of the globe.

- To explore the role of geo-political risk in spatial convergence in security, equity and sustainability in developing countries of the globe.
- To explore the heterogeneous effect of geo-political risk on the convergence of security, equity and sustainability of energy in developing countries of the globe.

4. Literature Review

Ren, Yang and Jin (2024) investigate the effect of geopolitical risk (GPR) and convergences of green energy consumption (GEC) on the conditional spatial β convergence and found that there exist a spatial σ and γ-convergence, absolute and conditional spatial β convergence in terms of GEC however, conditional spatial β convergence of GEC and GPR are adversely related to each other. The key factor of correlation of conditional spatial β convergence of GEC and GPR is the fluctuating oil price. The results further show that the GPR and GEC have positive impacts on energy security. Khan et al. (2022) explore the impact of global energy trilemma on economic growth and environmental sustainability in the bottom ten and top ten selected economies from 1990-2016. The findings designate that world energy trilemma and transformative energy concurrently complement economic growth and ensure environmental sustainability. Similarly, investments in non-financial assets help to advance economic growth but at the cost of environmental sustainability. This further suggests that economies should focus on the rationality of energy policy according to the dimensions of energy trilemma for a sustainable energy system. Cai and Wu (2021) investigate the dynamic interactions between the geopolitical risk (GPR) and the growth of renewable energy consumption (GREC) by employing a Bayesian Vector Autoregressive model. The results show that the shocks of GPR leave a positive impact on GREC. In contrast, GREC shocks negatively GPR in the whole sample period. These results substantiate the fact that renewable energy plays a positive role in reducing geopolitical risks. However, at the same time geopolitical risks support the consumption of renewable energy.

5. Hypotheses/research questions to be tested

Based on study conceptual framework, this study will attempt the following research question and will test the following hypotheses.

- **Hypothesis 1:** Spatial factors play a substantial role in determination of energy security, equity, and sustainability in developing economies of the globe.
- **Hypothesis 2:** There exists spatial β-convergence and spatialσ-convergence in energy security, equity, and sustainability in developing economies of globe.
- **Hypothesis 3:** Geo-political risk negatively affects spatial convergence in energy security, equity, and sustainability in developing economies of the globe.
- **Hypothesis 4:** Geo-political risk has heterogeneous effect on the convergence in energy security, equity and sustainability based on the income level (low and middle) of the developing countries.

6. Analytical Methods: Economic theory that your study will rely on for testing hypotheses/answering research questions

This study is based on three pieces of existing literature which provide the analytical framework of the issue in hand. First, the literature suggests that energy consumption is primarily supported by neo-classical growth model which predicts convergence in income levels of the countries. Hence, there should be convergence in energy consumption as well. Secondly, spatial factors are found to be

important in determining state of energy in different countries. This is due to increased globalization and trade and there is increased spatial spillover in the state of energy among neighboring countries. This is not only because there are commodity and labor flow among countries but also countries mimic energy policies of the neighboring states. Finally, geo-political risks remained an important factor in determining the state of energy since the 1970s crisis. This study intends to incorporate the insights into these three strands of literature into analysis to assess the state of energy in developing countries and then assess the heterogeneity based on the income level of the developing countries. Specially, this study first asses the role of spatial factors in determination of security, equity and sustainability of energy. Then it will test the existence of spatial convergence and check how geo-political risks will affect convergence level.

7. Description of the Study Site and data

This study will use secondary data of various macroeconomic variables for developing countries.

8. Proposed Empirical Analysis Estimation Techniques

- For spatial dependence we will use spatial maps, hot-spot and cold-spot analysis along with quantitative measures like Global Moran's I and Local Indicators of Spatial Association.
- For spatial β-convergence, absolute and conditional convergence will be estimated by using Spatial model (SAR, SEM and SDM). For spatial σ-convergence, Spatial Distributional Approach will be employed.
- Role of geo-political risk in determining spatial convergence will be tested by treating it as a conditioning factor in β-convergence and as a conditioning factor in Stochastic Kernel while doing distribution analysis.
- Heterogeneity between economies will be studied by splitting the sample based on the income level of the countries.

9. Potential Policy Implications

The study has the following potential policy implications:

- Firstly, if spatial factors are found to significantly influence the security, equity, and sustainability of energy, policymakers can prioritize strengthening regional cooperation among neighboring countries. Such enhanced collaboration could enable countries to better improve and optimize their existing energy resources and infrastructure.
- Secondly, if convergence in the security, equity, and sustainability of energy is proved, developing countries may eventually achieve similar levels of energy development. This convergence could create opportunities for these countries to collaborate on unfolding the existing energy policies and establish collective frameworks for achieving their shared energy objectives.

10. Acknowledgment

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11. Base Papers

Ren, X., Yang, W., & Jin, Y. (2024). Geopolitical risk and renewable energy consumption: Evidence from a spatial convergence perspective. Energy Economics, 107384.

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