

Exploring the drivers of energy security and energy equity in developing countries

Leila Dagher, leiladagher@lau.edu.lb, Lebanese American University

Overview

Building on prior research examining energy security (ES) and energy equity (EE) across global economies, this study shifts its focus to the unique challenges faced by developing countries during the global transition to renewable energy. Developing economies are particularly vulnerable to fluctuations in energy availability and access due to weaker institutional frameworks, limited infrastructure, and uneven integration into global financial markets. This research investigates how financial integration, political stability, infrastructure quality, and urbanization shape ES and EE in developing contexts, emphasizing socio-economic trade-offs and policy implications.

The study seeks to fill the critical gap in understanding how governance and technological advancements interact with economic systems to affect energy outcomes in resource-constrained environments. Specifically, it explores the balancing act between energy availability, affordability, and inclusiveness, contributing fresh insights into how policymakers in developing regions can align sustainable energy policies with growth and equity goals.

Methods

The research uses an extensive panel dataset covering 35 developing countries from 2005 to 2020. Key variables include financial integration (capital flow data), political stability (Worldwide Governance Indicators), infrastructure quality, urbanization rates, and technological adoption. System Generalized Method of Moments (GMM) is employed to address endogeneity concerns, alongside Fixed Effects (FE) and Random Effects (RE) models to ensure robustness. A unique aspect of the methodology is the incorporation of interaction terms to analyze how political stability moderates the relationship between financial integration and ES, and how social integration and urbanization jointly influence EE.

Data sources include the World Bank, UNSDG energy indicators, and trade and investment datasets, ensuring comprehensive coverage. Diagnostic tests for serial correlation and multicollinearity are performed to validate the models.

Results

The results show that financial integration positively influences ES, as increased capital flow enables investments in energy infrastructure critical for stability. Political stability, as hypothesized, further strengthens this effect by reducing policy uncertainty and investment risk. Conversely, infrastructure's impact on ES is mixed, with significant effects in static models but diminishing significance when using dynamic GMM estimation, reflecting implementation lags in infrastructure projects.

In terms of EE, urbanization negatively impacts equitable energy access, highlighting growing disparities in rapidly expanding urban areas. Trade openness and technological advancements emerge as positive drivers, enhancing access through competitive pricing and efficient distribution networks. Inflation and rising energy intensity negatively affect affordability, disproportionately impacting lower-income populations in the sample countries.

Conclusions

To enhance ES and EE, policymakers in developing countries should prioritize strategies that improve access to international capital for large-scale energy infrastructure. Regulatory reforms aimed at increasing financial market

openness can attract foreign direct investment (FDI), easing resource constraints. Strengthening political institutions to foster policy stability and investor confidence is equally crucial for long-term energy infrastructure sustainability.

Urban planning policies must address the energy demands of growing populations by integrating smart grid technologies and expanding decentralized renewable systems. Investments in technological R&D and digital connectivity are key to driving both efficiency and equity in energy distribution. Finally, targeted social policies, such as subsidies for vulnerable groups and community energy projects, are vital to mitigate disparities and enhance social inclusion in energy access. These steps will help developing nations achieve a more balanced, resilient, and sustainable energy future.

References

- Apergi, M., Eicke, L., Goldthau, A., Hashem, M., Huneus, S., de Oliveira, R.L., Otieno, M., Schuch, E. and Veit, K., 2024. An energy justice index for the energy transition in the global South. *Renewable and Sustainable Energy Reviews*, 192, p.114238.
- AYAZ, M. T., Prodromou, T., Le, T., & Nepal, R. (2024). Energy security dimensions and economic growth in Non-OECD Asia: An analysis on the role of institutional quality with energy policy implications. *Energy Policy*, 188, 114090.
- Belaïd, F., Al-Sarihi, A., & Al-Mestneer, R. (2023). Balancing climate mitigation and energy security goals amid converging global energy crises: The role of green investments. *Renewable Energy*, 205, 534-542.
- Blum, H., & Legey, L. F. (2012). The challenging economics of energy security: Ensuring energy benefits in support to sustainable development. *Energy Economics*, 34(6), 1982-1989.
- Cherp, A., & Jewell, J. (2014). The concept of energy security: Beyond the four As. *Energy policy*, 75, 415-421. <https://doi.org/10.1016/j.enpol.2014.09.005>
- Filipović, S., Radovanović, M., & Golušin, V. (2018). Macroeconomic and political aspects of energy security—Exploratory data analysis. *Renewable and Sustainable Energy Reviews*, 97, 428-435.
- Iyke, B. N. (2024). Climate change, energy security risk, and clean energy investment. *Energy Economics*, 129, 107225.
- Siksnyte-Butkiene, I., Streimikiene, D., Lekavicius, V., & Balezentis, T. (2024). Comprehensive analysis of energy security indicators and measurement of their integrity. *Technological Forecasting and Social Change*, 200, 123167.
- Valdes, J. (2021). Participation, equity and access in global energy security provision: towards a comprehensive perspective. *Energy Research & Social Science*, 78, 102090.
- Winzer, C. (2012). Conceptualizing energy security. *Energy policy*, 46, 36-48. <https://doi.org/10.1016/j.enpol.2012.02.067>
- Xie, B., & Xie, B. (2024). Assessing the impact of climate policy on energy security in developed economies. *International Review of Economics & Finance*, 90, 265-282.