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Energy Independence Risk and Energy Policy Risk: Theory and Empirical Testing

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ABSTRACT

The study investigates the unique relation in the middle of regulatory risk in the energy sector and energy independence risk across 135 countries from 2000 to 2023. The method of moments quantile regression (MMQR) is conducted for the empirical estimations along with the second generation methods such as CIPS unit root and Westerlund cointegration tests. The outcomes illustrate a vital positive effect of power policy risk on energy independence risk across all the (10%-90%) quantiles of the regression. The policy implications are provided to consider the function of energy policy in achieving fuel independence.

Keywords: Energy Policy Risk, Energy Independence Risk, MMQR
JEL Classifications: Q41, Q48, C31

I. INTRODUCTION

Recent growing tensions in energy markets are causing the formation of new energy variables such as energy independence risk and energy policy risk. When a country or region is not unduly dependent on outside sources to meet its energy demands, it is said to be energy independent (Wen et al., 2024). It is less susceptible to supply interruptions, price swings, and geopolitical conflicts associated with energy imports because a sizable amount of its energy is produced domestically (Deutch, 2005; Jewell et al., 2016; Yemelyanov et al., 2019). As regards fuel policy, a government, organization, or individual's set of rules, regulations, and goals for controlling the production, distribution, and use of energy is known as its energy policy. It seeks to guarantee the sustainable, economical, and secure production, distribution, and consumption of energy (Kanna et al., 2024). Energy is the lifeline of a modern economy and a foundation for development (World Bank, 2025).

It can clearly be seen that energy policy impacts energy independence. For example, according to Flores-Chamba et al. (2019), a number of EU initiatives lower energy use, simultaneously increasing energy independence. The relation from energy policy to energy independence might be well shown through the composites of the two variables. More specifically, a nation is energy independent if energy production is effectively managed. The studies by Fung et al. (2004) and Kang et al. (2018) also show that investments into energy by China cause diversified energy production in Africa, thus reducing energy dependence.

Although literature shows that energy policy risk can impact on energy independence risk theoretically, there is no study examining this association. But other studies about the factors that impact on energy risk indicate that the high level of carbon emission volatility shows considerable environment related and political risks that must be integrated into planning of renewable energy. Such volatility recommends that political issues should not only aim emission levels but also address the uncertainty of energy-related procedures, which directly connected with the broader approaches of energy independence and energy policy risk (Kuziboev et al., 2023). For example, while insurance coverage or alternative risk mitigation is severely limited, governmental and regulatory issues seem to be a significant obstacle to investments in renewable energy (Gatzert and Kosub, 2016). In contrast, despite its political appeal, concentrating on energy independence is a misguiding pursuit that may actually divert attention from the more crucial goal of overseeing the shift to a more secure and sustainable energy future in a globalized world (Verrastro and Ladislaw, 2007). Therefore, to fill this limitation in the literature, the present work assesses the theoretical effect of energy policy risk on fuel independence risk. To validate the theoretical linkage effectively, MMQR is employed since this estimator calculates the effect of power policy risk on the divergent quantiles of power independence risk.

2. LITERATURE REVIEW

In literature, the interest to investigate the relation in the middle of fuel policy also power independence is growing. More specifically, Wen et al. (2024) examine the relation in the middle of Chinese funding also independence in energy supply around Africa. They analysed panel data from 28 countries in Africa in the middle of 2003-2022. Findings reveal that Chinese funding has a vital positive impact on energy independence, highlighting its role in strengthening Africa's domestic energy production. Zhang and Usman (2025) explore the relation between subsidies for fossil fuels, energy balance dynamics, and geopolitical risk across politically unstable countries from 2010 to 2023. The findings underscore the importance of phasing out fossil fuel subsidies, advancing renewable energy investments as well as broadening energy diversification so as to reduce vulnerability to geopolitical shocks. By reinforcing domestic energy generation, fostering interregional partnerships, and redirecting hydrocarbon revenues toward green development, states are able to enhance energy security and support greater geopolitical resilience. As well as, Sattich et al. (2022) explores the role of energy security perceptions in steering Lithuania's recent energy strategy. The evidence suggests that renewable energy policy was framed around potential energy security concerns, yet diverging from securitization theory, the decisive factor enabling renewable energy expansion was the attainment of a heightened sense of energy security. Moreover, Rivera-Rodríguez et al. (2025) examines how natural and structural disasters intersect with mental health and energy independence in the Puerto Rican context. Results demonstrate that participants benefiting from direct or indirect solar panel access conveyed positive outlooks and hopeful narratives concerning their psychological well-being and life quality. Hughes (2014) investigates how to contribute to energy security in domestic oil policy can be used to measure the marginal role of oil import dependence in determining U.S. foreign policy behaviour toward oil. Evidence suggests that support for lowering oil import risks is predominantly associated with unilateralist lawmakers favouring greater freedom of action in international affairs. Furthermore, Bu and Zhang (2025) examines the extent to which decentralized energy transition policies influence firms' movement toward sustainable green transformation. Findings reveal that the NEDC policy plays a significant role in promoting greener practices among high-energy-consuming firms while simultaneously lowering carbon emissions in pilot cities. Tiwari et al. (2025) examines how far the notion of energy resilience has been embedded within energy policy studies and suggests directions for future inquiry to enhance its role in policymaking. Results demonstrate that energy resilience is either overlooked within energy policy scholarship or, viewed differently, energy policy analysis is missing from the broader debates on energy resilience. Wen et al. (2024) explores how Chinese investment relates to energy independence across African nations. Results show, first, a significant positive correlation suggesting that Chinese financial flows enhance domestic energy generation capacity. Second, the impact is stronger in countries with abundant natural resources, reflecting China's preference for resource-rich environments. Third, institutional quality was not found to play a moderating role in shaping the link between Chinese investment and energy independence.

3. DATA AND METHODOLOGY

3.1. Data

The study explores the association among energy independence risk, energy policy risk renewable energy, economic development and fossil fuel in the panel of 135 countries, using annual data from 2000 to 2023. Energy independence risk (ENIND) is applied as the explained variable, measured in a score from 0 to 100. High score means less risk of energy independence. Energy policy risk (ENPOL), measured in a score from 0 to 100, indicating less risk for a high score, is exploited as the main explanatory variable. As control variables, economic development, renewable energy and fossil energy are employed as the further determinants of energy independence in the study by Wen et al. (2024).

More precisely, Gozgor and Paramati (2022) explore influnce of energy diversification on socio-economic growth in the study examines panels of low-income, high-income, European Union, OECD, and other nations, and finds that major economies experience sustained economic growth as long-term energy diversification increases. Moreover, Wen et al. (2024) investigates the nexus between Chinese funding and energy security in Africa. These findings suggest that, in contrast to the widespread adverse perception of China–Africa relations, China could serve as a constructive partner in advancing energy independence, achieving SDG, and supporting the "Sustainable Energy for All" agenda. Moreover, the outcomes remain consistent across alternative measures and are not affected by potential endogeneity concerns. Also, Turan and Toto (2025) assess the EKC hypothesis within the context of Western Balkan countries between 2006 and 2019, focusing on how the bank industry and financial growth influence environmental sustainability. Using the AMG method under panel estimation, the findings confirm the EKC hypothesis, showing that economic growth and energy use substantially deteriorate environmental quality in the region. Apart from these Kuziboev et al., (2024) investigated the relationship among CO_2 emissions, remittances, energy consumption and economic development around the countries in Central Asia (Uzbekistan, Kazakhstan, Kyrgyzstan and Tajikistan) analysing the period of 1995–2022. Central Asian economies have a strong influence on global market volatility due to their high dependence on fossil fuel energy as well as reliance on imported energy resources in many cases, which exacerbates their energy security vulnerabilities. Such structural dependence limits sustainable development pathways by increasing sensitivity to external price fluctuations and environmental pressures. Therefore, the introduction of policies aimed at improving efficiency of energy and diversifying energy sources is crucial to reduce the impact of market fluctuations, strengthen energy independence and ensure long-term environmental sustainability and economic growth (Kuziboev et al., 2024).

Furthermore, Viglioni et al. (2025) examines the effect of economic complexity on renewable energy utilization. The findings indicate that economic complexity exerts a negative influence on clean energy production. As economies expand, increased demand for energy to sustain infrastructure development and industrialization leads to higher energy imports and, consequently, a reduction in energy independence (Chu et al., 2023). Moreover, Yang and Zhan (2024) construct a four-dimensional evaluation framework for energy security tailored to China's prevailing energy market and economic conditions. By employing renewable energy generation and technological innovation as key measures of renewable energy development, the analysis demonstrates that renewable electricity generation contributes positively to energy security, though its impact is not consistently significant across every dimension of energy independence. As well as, Tugcu and Menegaki (2024) analyse the relationship between clean energy generation and energy security over the period 1980–2018. The findings indicate a unidirectional causal relationship from renewable energy to energy security in the short term, while in the long term, renewable energy production substantially mitigates risks that undermine energy security. Moreover, Wang and Tian (2025) explore the effect of green energy consumption on energy independence risk, accounting for the intermediate influences of economic policy uncertainty, globalization, economic performance, and natural resources during the period 1990–2023. The results demonstrate that increased clean energy consumption contributes to reducing energy security risks. Additionally, Caporin et al. (2024) argue that in the process of analysing the role of green, blue and energy sources to economic development in Central Asia, the energy infrastructure of the region, depending mainly on fossil fuels, is creating high levels of energy independence risk and energy security risk. The research indicates that heavy technical losses in existing energy and water infrastructure and poor diversification in energy resources further exacerbate the risks and threaten long-term economic stability. At the same time, the authors justify that expanding renewable energy consumption, diversifying energy sources and alleviating the transition to a green economy can help significantly reduce energy independence risk and energy security risk in the region (Caporin et al., 2024).

Furthermore, Li et al. (2024) provide a comprehensive evaluation of energy security in China's Yangtze River Delta from 2000 to 2019, emphasizing the important position of electricity indicators in the energy transition through an integrated optimization model based on the entropy method. The results underscore supply security as the primary factor in ensuring overall energy security. Also, Chavda and Mehta (2025) studies the effects of fossil fuel subsidies and environmental taxes on renewable energy consumption within OECD countries. The findings underscore the necessity of progressively phasing out fossil fuel subsidies and enhancing environmental taxation to facilitate a faster transition to green energy. In addition, Kuziboev et al., (2023) studied the International Energy report and note that CO_2 emissions associated with the energy sector may quadruple by 2050 if strict and specific measures are not taken globally. Such negative dynamics not only accelerate the process of climate change, but also significantly increase the risks associated with energy security (energy security risk) and energy independence (energy independence risk), increasing the dependence of countries and regions on external resources due to the continuous increase in oil demand. As a result, this process can extend the duration of the implementation of the set tasks for the fight against climate change-goal 13 from the goals of sustainable development, as well as further complicate the transition to green energy (Kuziboev et al., 2023). Moreover, Tarkun (2025) investigates the evolving informational interactions between fossil fuels and strategic metals amid the global energy transition. The findings reveal a restructuring of energy-related influence networks, emphasizing the increasing importance of resource-critical markets in determining expectations, market volatility, and long-term strategic planning. As well as, Li et al. (2024) examines the effect of fossil fuel subsidies on energy-saving technological diversification. The results indicate that technological progress demonstrates an energy-saving bias in the interaction between energy and investment, while showing a labour-saving bias in the relationship between energy and labour.

Economic development (ECDEV), measured as GDP per capita in US dollars; fossil fuel energy (FOSEN), measured as the percentage of fossil fuels in total electricity; and renewable energy (RENEW), measured as the percentage of renewables in total electricity, are employed as the control variables. The data of energy independence risk and energy policy risk are obtained from Refinitive, whereas per capita GDP is downloaded from World Bank Data, and fossil fuels and renewable energy are taken from Our World in Data.

Energy independence risk, energy policy risk, and economic development are used in logarithmic transformation, such as LOGENIND, LOGENPOL, and LOGECDEV.

3.2. Methodology

3.2.1 Cross-sectional dependence and panel unit roots

As an initial stage, the cross-sectional dependence (CD) test should be run. To this end, the Pesaran (2015) test is applied. The general representation of the CD test is as follows:

$$CD = \left[\frac{TN(N-1)}{2}\right]^{1/2} \hat{\bar{p}}_N \quad (1)$$

where $\hat{\bar{p}}_N$ is

$$\hat{\bar{p}}_N = \frac{2}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij} \quad (2)$$

$\hat{p}_{ij}$ is already defined in the equation of CD test by Pesaran (2004):

$$\hat{p}_{ij} = \hat{p}_{ji} = \frac{\sum_{t=1}^{T} e_{it} e_{jt}}{(\sum_{t=1}^{T} e_{it}^2)^{1/2} (\sum_{t=1}^{T} e_{jt}^2)^{1/2}} \quad (3)$$

The existence of cross-sectional dependency necessitates that panel time series methodologies address this issue appropriately. This study utilizes the cross-sectional CIPS panel unit root test to analyze the unit root characteristics of the variables while considering cross-sectional dependence. To compute CIPS statistics, the regression model used for the cross-sectional augmented Dickey-Fuller (CADF) test is conducted as follows:

$$\Delta Z_{it} = \alpha_i + \rho_i Z_{i,t-1} + \beta_i \bar{Z}_{t-1} + \sum_{j=0}^{k} \gamma_{ij} \Delta \bar{Z}_{i,t-1} + \sum_{j=0}^{k} \delta_{ij} Z_{i,t-1} + v_{it} \quad (4)$$

The final step involves computing the CIPS statistic, which is the average of CADF statistics, using the formula:

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} t_i(N,T) \quad (5)$$

3.2.2. Panel cointegration test

If unit root tests indicate the same extent of integration of the series, the existence of long-run association among the variables can be investigated with panel cointegration tests. In this paper we employ Westerlund's (2005) panel cointegration test to analyze cointegration.

To apply the Westerlund (2005) test, firstly the residuals are obtained from the estimation of Equation (1). Then they are tested for a unit root based on the following model following the AR(1) process:

$$\hat{\varepsilon}_{it} = \rho_i \hat{\varepsilon}_{it-1} + u_{it} \quad (6)$$

The variance ratio statistics used for the analysis of cointegration are defined as follows:

$$VR_G = \frac{1}{N} \sum_{i=1}^{N} \frac{\sum_{t=1}^{T} E_{it}^2}{R_i} \quad (7)$$

$$VR_p = \frac{\sum_{i=1}^{N} \sum_{t=1}^{T} E_{it}^2}{R_i} \quad (8)$$

Where $E_{it} = \sum_{j=1}^{t} \varepsilon_{ij}$ and $R_i = \sum_{t=1}^{t} \varepsilon_{it}{}^2$

3.2.3. MMQR

This paper utilizes the MMQR to study the impact of fuel policy risk on the power independence risk of the countries. The MMQR method allows us to investigate the influence of the independent variable over the various quantiles of the dependent variable, thus coping with heteroscedasticity caused by economic fluctuations such as wars, pandemics, natural disasters, financial crises, and other uncertainties. As to Machado and Silva (2019), in order to evaluate the MMQR model, the initial linear panel data model is changed as follows:

$$\text{LOGENIND}_{it} = \alpha_i + X_{it}^{'} \beta + (\delta_i + Z_{it}^{'} \gamma) U_{it} \quad (9)$$

β denotes the vector comprising the coefficients of the explanatory variables matrix i.e. $X_{it}^{'} = [\text{LOGENPOL}_{it}\ LOGECDEV_{it} RENEW_{it}\ FOSEN_{it}]$. α_i refers to the individual-specific fixed impact, during δ_I refers to the country-specific fixed effect corresponding to each quantile i. Zit represents a vector consisting of diverse changes of the explanatory indicators which meet the probability requirement $P\left\{\delta_i + Z_{it}^{'} \gamma > 0\right\} = 1$. U_{it} is a random variable that is imperceptible and is not connected with explanatory variables. It has been regularized to meet the moment conditions below:

The expected value of U_{it} is zero, $E(U_{it}) = 0$, whereas the expected absolute value of U_{it} is tantamount to one $E(|U_{it}|) = 1$.

The variables of Equation (11), i.e. α_i, β', δ_i, γ' and q(τ)', are calculated based on the initial moment conditions while accounting for the explanatory variables' exogeneity. This evaluation method follows the method depicted by Machado and Silva (2019). Thus, the conditional quantile demonstration of the model is described as:

$$Q_{LOGENIND_{it}}\left(\tau \middle| X_{it}\right) = \left(\alpha_i + \delta_i q\left(\tau\right)\right) + X_{it}^{'} \beta + Z_{it}^{'} \gamma q(\tau) \quad (10)$$

This evaluates the conditional quantiles of the response variable ($LOGENIND_{it}$, related to the explanatory variables, and it takes into account a panel of individuals studied over several periods of time. The quantile-τ fixed effect for individual *i*, or the distributional impact on τ, is presented by the scalar parameter $i(\tau) \equiv (\alpha_i + \delta_i q(\tau))$ in parenthesis. The one-step GMM estimator developed by Hansen (1982) is used to estimate the model above.

4. EMPIRICAL SECTION

4.1. Test for Cross-sectional Dependence (CD)

As the first step, the CD test (Pesaran, 2015) is run. Since the P-values of all tests given in Table 1 are statistically vital at 1% level, cross-sectional dependence is confirmed in the regression model's residuals on the basis of the employed variables, LOGENIND, LOGENPOL, LOGECDEV RENEW, and FOSEN.

4.2. Test of Unit Root

As long as the cross-sectional dependence exists, second-generation methods must be applied. Therefore, the CIPS unit root (Pesaran, 2007) test is run to check the variables` stationarity. According to the findings (Table 1), all studied variables, LOGENIND, LOGENPOL, LOGECDEV RENEW, and FOSEN, are integrated in the first differences since P-values are statistically crucial at the level of 1%.

4.3 Cointegration Test

The confirmation of dependence which is cross-sectional and the variables` integrated order in the first differences lead to conducting the Westerlund (2005) cointegration test to check long-term connectedness between the employed factors. On the estimations shown in Table 1, the long-term nexus of the used factors, LOGENIND, LOGENPOL, LOGECDEV, RENEW, and FOSEN, since the test`s all p-values are statistically significant. The existence of cointegrating relations around the indicators motivates building models to estimate.

4.4. Empirical Results

The estimations given in Table 2 show that energy policy risk has a beneficial influence on energy independence risk across all the quantiles from 10% to 90%. This finding is in line with the theoretical linkage. Moreover, the results are similar to those by Wen et al. (2024), who find that high institutional quality and political stability lead to African energy independence. Petrovic and Ostojic (2025) induced uncertainty and geopolitical risk do not exert a significant long-term influence on renewable energy production. In contrast, factors such as gross domestic product, the structure of final energy consumption, financial development, greenhouse gas emissions, gross fixed capital formation, and the average annual crude oil price demonstrate a positive long-term effect. Moreover, Tabash et al. (2024) found a vital positive correlation between geopolitical risk and renewable energy consumption, indicating that higher levels of geopolitical risk are connected with increased adoption and utilization of clean energy resources.

Regarding the effect of control variables on energy independence risk, economic development increases energy independence risk. The findings underscore the necessity for policymakers to gradually eliminate subsidies for fossil fuels, encourage investment in green energy, and expand energy diversification as measures so as to reduce geopolitical vulnerabilities. Additionally, reinforcing domestic energy production, enhancing regional collaboration, and strategically channelling oil and gas income into sustainable goals can strengthen independence of energy and support geopolitical stability (Zhang and Usman, 2025). Moreover, Miao et al. (2025) indicate that fossil fuel consumption undermines green economic growth domestically and generates negative spatial spillover effects, thereby impeding sustainability in neighbouring economies. Conversely, renewable energy contributes positively to the home country's growth and produces favourable spatial spillovers, enhancing sustainability in surrounding regions.

Renewable energy consumption decreases energy independence risk. Su et al. (2025) investigate high energy-related uncertainty prices decrease the attraction of renewable energy plans and obstruct the transition to renewable energy. This results that augmenting the renewable energy consumption can reduce energy-related uncertainty risk. The adoption of renewable energy is considered an efficient approach to diminish energy-related uncertainty risk and support energy security. As well as, there exists a unidirectional causal relationship from renewable energy to energy security in the short term, while the generation of energy from renewable sources substantially mitigates long-term risks to energy security (Tugcu and Menegaki, 2024). Moreover, Khan et al. (2024) confirms that renewable energy has affected energy security by mitigating the negative results of climate change, enhancing the reliability of oil supplies, and through the enactment of policies and incentives aimed at promoting renewable energy. Furthermore, Aslam et al. (2024) examine energy transition as

Table 1: The results of CD, CIPS and Westerlund tests

CD test		
Test	**Statistic**	**P-values**
CD	30.364	0.000
CIPS test		
Variables	**Level**	**First difference**
LOGENIND	−1.374	−2.878***
LOGENPOL	−1.586	−3.002
LOGECDEV	−2.336***	−3.919***
RENEW	−1.952	−4.392***
FOSEN	−1.980	−4.517***
Westerlund test		
	Statistic	**P-value**
Variance ratio	11.752	0.000

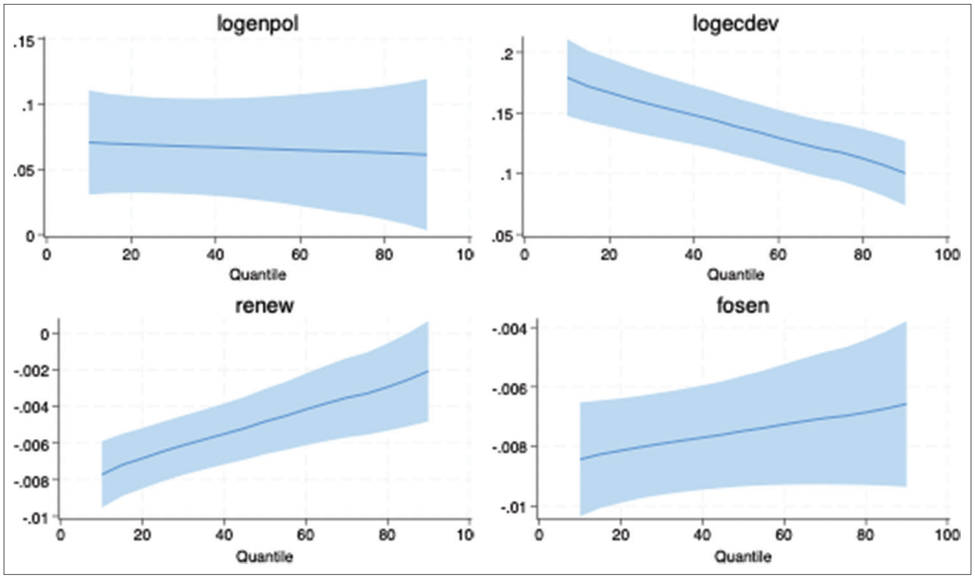
The above-mentioned table reports CD test to check cross-sectional dependence in the residuals of the regression model, CIPS test to investigate the stationarity of LOGENIND, LOGENPOL, LOGECDEV, RENEW and FOSEN, Westerlund test to examine the cointegrating relations across the indicators. ***Expresses statistical significance of 1% level

Table 2: The results estimated by MMQR

Dependent variable: LOGENIND	Quantiles								
Variables	10%	20%	30%	40%	50%	60%	70%	80%	90%
LOGENPOL	0.070	0.069	0.068	0.067	0.065	0.064	0.063	0.062	0.061
P-value	0.001	0.000	0.000	0.000	0.000	0.003	0.008	0.016	0.039
LOGECDEV	0.179	0.166	0.156	0.148	0.138	0.129	0.120	0.112	0.100
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FOSEN	−0.008	−0.008	−0.007	−0.007	−0.007	−0.007	−0.007	−0.006	−0.006
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RENEW	−0.007	−0.006	−0.006	−0.005	−0.004	−0.004	−0.003	−0.002	−0.002
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.016	0.141
Constant	1.633	1.772	1.883	1.979	2.085	2.189	2.288	2.379	2.514
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

This table reports the evaluated coefficients by MMQR method, and *P* values as well

Figure 1: Marginal effects



This plot shows the marginal effects of LOGENPOL, LOGECDEV, RENEW and FOSEN on LOGENIND

a key variable and finds that the adoption of renewable energy resources significantly reduces energy security risk. It further recommends that structural shifts toward energy transition be implemented to mitigate energy security risks in the selected Belt and Road Initiative countries.

Fossil fuel energy consumption decreases energy independence risk. Hille and Angerpointner (2025) identifies evidence of a partial transition from fossil fuels to clean energy in response to geopolitical risks abroad. Specifically, as fossil fuel consumption declined partially, rising geopolitical risks in coal-supplying countries corresponded with a rise in green energy utilization. Also, Wang and Tian (2025) demonstrate that renewable energy consumption mitigates energy security risks. They also find that economic development reduces energy independence risk over the long term, whereas in the short-run, it tends to elevate such risks.

The marginal impact of fuel policy risk on fuel independence risk shows a decreasing trend, meaning that an additional unit of effective energy policy has less impact to achieve energy independence (Figure 1).

5. CONCLUSION

This research is a pioneer in analysing the effect of energy policy risk on power independence risk. The relation is estimated applying the MMQR method. The findings reveal that effective energy policy leads to achieving energy independence, validating the theory. More precisely, energy policy risk positively influences energy independence risk across all the quantiles, 10-90%.

The realization of energy independence is closely tied to the development and execution of energy strategies that focus on sustainable practices, resource diversification, and innovative solutions. By promoting large-scale deployment of renewable energy, electrification of key sectors, and the development of emerging technologies such as green hydrogen, governments can substantially decrease reliance on imported mineral fuels while strengthening domestic fuel security. A well-structured energy policy also mitigates price volatility, stimulates long-term economic savings, and fosters industrial competitiveness through investment in clean technologies. Furthermore, integrating social and environmental dimensions into policy frameworks ensures that the benefits of energy independence extend beyond economic stability to include improved public health, environmental protection, and societal resilience. Ultimately, strategic and adaptive energy policymaking serves as the cornerstone for achieving true energy independence and securing a sustainable future. The development of renewable energy communities highlights the importance of local engagement, where cost savings and energy self-sufficiency are strong motivators, yet technical challenges must be carefully addressed. Collectively, these insights underscore that the transition to clean energy systems represents not merely an environmental imperative but also a strategic opportunity to enhance resilience, economic security, and societal well-being across diverse contexts.

The attainment of energy security is inseparable from the formulation of coherent and synergistic energy and economic development policies. Effective energy policy must be complemented by economic strategies that foster sustainable growth, stimulate investment in renewable technologies, and reduce reliance on fossil fuel imports. Economic development policy plays a critical role by creating favourable market conditions, supporting innovation, and incentivizing efficiency improvements that collectively enhance energy security. Moreover, aligning economic growth objectives with clean energy transitions ensures that expansion in industrial output, trade, and consumption does not exacerbate energy dependence but instead contributes to long-term sustainability. In this regard, economic development policy acts as both an enabler and a regulator, balancing the imperatives of growth with the necessity of reducing environmental externalities. In conclusion, aligning energy policy with economic development strategies offers a holistic route to attaining energy independence, ensuring macroeconomic stability, and fostering long-term sustainable growth.

Achieving energy independence fundamentally relies on the establishment of effective renewable energy policies that strategically transform national energy systems. Renewable energy policy plays a pivotal role by accelerating the deployment of clean technologies, reducing dependence on imported fossil fuels, and ensuring long-term energy security. Through targeted incentives, regulatory frameworks, and investment in infrastructure, renewable energy policy creates the conditions necessary for expanding the share of solar, wind, hydro, and other sustainable sources within the energy mix. Furthermore, such policies stimulate innovation, promote industrial competitiveness, and generate essential socio-economic benefits, including job creation and improved public health outcomes. The alignment of renewable energy development with sustainability and economic strategies provides policymakers with an effective means to limit ecological damage, ensure predictable energy costs, and improve resistance to global market disruptions. Ultimately, renewable energy policy serves as a cornerstone of effective energy governance, offering a comprehensive pathway toward energy independence, sustainable growth, and climate responsibility.

The pursuit of energy security requires not only the advancement of clean energy but also the strategic management of fossil energy policy. Fossil fuel resources remain integral to many national economies, and their effective governance can significantly influence the stability and security of the energy system. A well-designed fossil energy policy contributes to energy independence by optimizing domestic resource utilization, reducing unnecessary import dependence, and ensuring efficient allocation of fossil energy in critical sectors. At the same time, such a policy must be oriented toward gradual diversification of the energy mix, supporting a managed transition toward cleaner alternatives while safeguarding economic stability. By incorporating measures for efficiency, technological innovation, and environmental regulation, fossil energy policy can balance the short-term necessity of fossil fuels with long-term sustainability goals. Fossil energy policy, aligned with overarching energy objectives, assumes a transitional but significant role in advancing energy independence, safeguarding against external vulnerabilities, and strengthening sustainable economic progress.

The study has also limitations. For instance, it might be helpful to check the effect of power policy risk on power independence risk by dividing the sample by economic development stage. However, given the word limit, this task might be done in future works.

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