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# Geopolitical Oil Shocks, Energy Vulnerability, and Renewable Energy Resilience in Africa: Evidence from the Iran War Shock

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## Chronicle

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## Abstract

This study examines how the Iran war shock affected domestic energy and inflation stress across African countries and whether these effects depended on fossil-fuel import dependence and renewable-energy resilience. Using a monthly panel of 20 African countries covering April 2023 to March 2026, the analysis investigates the transmission of an external geopolitical oil shock into domestic fuel prices and inflation. The study applies fixed-effects, dynamic fixed-effects, and two-step system GMM estimators to assess both the direct effect of the shock and the structural conditions shaping country-level vulnerability. The results show that the Iran war shock significantly increased fuel-price and inflation stress across the sample. More importantly, the adverse effects were stronger in countries with greater net energy import dependence and weaker in countries with higher renewable-energy shares. These findings remain robust across baseline and dynamic specifications. The dynamic results further indicate persistence in domestic fuel-price stress, while the system GMM estimates confirm the continued significance of the shock and the mitigating role of renewable energy. By contrast, the exploratory three-way interaction provides only weak evidence that renewable energy conditionally offsets the additional vulnerability associated with fossil-fuel dependence. Overall, the findings suggest that Africa's exposure to imported fossil fuels is a major channel through which geopolitical oil disruptions translate into domestic economic stress, whereas renewable energy serves as a measurable source of resilience. The study contributes to the literature by linking geopolitical oil shocks to African energy vulnerability in a panel-data framework and by showing that renewable transition should be understood not only as a climate strategy, but also as an energy-security and macroeconomic-stabilization strategy.

**Keywords:** Iran war shock; energy vulnerability; renewable energy resilience; fossil-fuel import dependence; fuel-price stress; Africa; panel data

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## INTRODUCTION

Africa's energy vulnerability has become impossible to ignore. The recent Iran war shock exposed how deeply many African economies remain tied to external fossil-fuel supply chains and how rapidly geopolitical conflict can be transmitted into domestic fuel prices, inflation, fiscal pressure, and broader macroeconomic instability. The disruption and closure risk surrounding the Strait of Hormuz, a route that normally carries around one-fifth of global oil trade, coincided with a sharp rise in energy prices in early 2026. Reuters reported Brent crude at around **$**115 per barrel, while the World Bank reported that its energy price index surged by 41.6% in March 2026, with crude oil prices increasing by more than 40% over the month (Reuters, 2026a; World Bank, 2026a, 2026b). These developments make clear that the Iran war shock was not simply a regional geopolitical disturbance; it was an external energy shock with immediate implications for import-dependent economies in Africa and beyond. The African consequences were immediate and severe. Reuters documented fuel-price increases and emergency policy responses across several African countries, including Ghana, Malawi, Tanzania, Mauritania, Gambia, Botswana, Mali, Senegal, South Africa, Morocco, and Egypt (Reuters, 2026a, 2026b, 2026c, 2026d). In Senegal, the government cut non-essential official travel because the oil price embedded in the budget $62 per barrel had become detached from market realities. In South Africa, the government introduced a temporary fuel-levy reduction to soften the impact of rising pump prices. Morocco relied on fuel reserves and transport subsidies to contain cost escalation, while Egypt increased electricity tariffs for heavier users to reduce fiscal pressure from higher import costs (Reuters, 2026b, 2026c, 2026d, 2026e). These responses are important because they show that the shock did not remain confined to international commodity markets; it was transmitted directly into domestic price administration, energy policy, and fiscal management.

The Gambian case reveals the same structural vulnerability with unusual clarity. In a government press release, the Ministry of Petroleum, Energy and Mines stated that the new indicative prices would have risen to D101.29 per litre for petrol and D124.72 per litre for diesel if fully passed through to consumers, corresponding to increases of approximately 22.78% and 47.43%, respectively. Instead, the government approved pump prices of D98.00 per litre for petrol and D95.00 per litre for diesel, implying subsidies of D3.29 per litre on petrol and D29.72 per litre on diesel, with a total subsidy burden of D316,146,722.52 for the period (Ministry of Petroleum, Energy and Mines, 2026). The Gambian experience is analytically important because it illustrates how fossil-fuel dependence materializes not only as a trade or energy issue, but as a direct budgetary burden and a real-time policy challenge. In other words, external oil shocks are absorbed domestically through subsidies, fiscal compromise, and reduced policy space.

Seen in this light, the Iran war shock is best understood as a structural stress test for Africa's fossil-fuel-dependent energy model. A growing literature argues that energy security depends not only on resource availability, but also on diversification, affordability, reliability, import exposure, and the structure of domestic energy systems (Kim et al., 2025; Tete et al., 2023; Ofosu-Peasah et al., 2024; Ajagun et al., 2024). This literature is especially relevant for Africa, where electricity systems remain fragile in many countries, energy imports are highly exposed to global price volatility, and infrastructure constraints weaken the capacity to absorb prolonged disruptions. Tete et al. (2023), for instance, show that energy security in the West African Economic and Monetary Union is shaped by availability, affordability, efficiency, governance, and sustainability, while Ofosu-Peasah et al. (2024) identify low infrastructure investment, high energy prices, and low electricity access as major energy-security challenges in West Africa. Ajagun et al. (2024) likewise argue that sub-Saharan Africa's energy future depends on stronger integrated systems, infrastructure investment, and policy coordination.

This energy-security perspective also changes how transition to renewable energy should be understood. The question is no longer only whether Africa should pursue renewables for environmental reasons; it is whether renewable energy can materially reduce African economies' vulnerability to external fossil-fuel shocks. Recent studies increasingly support that proposition. Kim et al. (2025) argue that the green transition is expected to have a net positive effect on energy security because it reduces fossil-fuel dependence and lowers import exposure, provided complementary investments are made in infrastructure and system adaptation. Aslam et al. (2024) find that greater renewable-energy transition reduces energy-security risk, while related evidence shows that renewable energy can lower energy-security risk in both advanced and developing settings (Cergibozan et al., 2022; Wang, 2025). In the African context, Nchofoung (2024) shows that oil price shocks adversely affect the continent's energy transition, highlighting the need for greater resilience in clean-energy investment and access. Taken together, these studies suggest that renewable energy should be framed not only as a decarbonization strategy, but also as a hedge against imported volatility and geopolitical disruption. At the same time, renewable-based resilience should not be treated as free of strategic dependence, since concentrated control over key technologies, storage systems, or critical mineral supply chains may create new forms of vulnerability even as dependence on imported petroleum is reduced.

The African policy relevance of this argument is substantial. Many countries on the continent remain exposed to imported petroleum products despite having significant renewable potential or, in some cases, domestic crude production. This exposure is compounded by weak refining capacity, limited storage, incomplete electricity access, and underdeveloped transmission and generation systems (Ofosu-Peasah et al., 2024; Ajagun et al., 2024; Tete et al., 2023). The Iran war shock shows how these structural weaknesses can quickly translate into fuel-price escalation, fiscal strain, and broader macroeconomic stress across African economies.

This study addresses that issue by examining whether the Iran war shock increased fuel-price and inflation stress more strongly in fossil-fuel-dependent African countries, and whether that effect was weaker in countries with greater renewable-energy mix. The paper is motivated by three related propositions. First, geopolitical oil shocks reveal underlying structural dependence more clearly than normal market fluctuations. Second, countries with greater fossil-fuel import dependence experience stronger knock on effects from external oil shocks into domestic energy stress. Third, countries with stronger renewable-energy bases are relatively more resilient because domestic renewable energy generation reduces exposure to internationally priced petroleum markets. In this sense, the paper does not approach renewable energy transition primarily as a normative environmental ambition. Rather, it treats renewable energy as a mechanism of building economic resilience, energy security, and macroeconomic stabilization.

The study contributes to the literature in several ways. First, it connects the geopolitical oil-shock literature to the African energy-transition debate by using the Iran war shock as a real-time external stress event. Second, it shifts the discussion from broad advocacy to a testable empirical question: whether renewable-energy capacity dampens the domestic effects of fossil-fuel shocks. Third, it contributes to the literature on energy security and transition by analyzing the interaction between fossil-fuel import dependence and renewable energy resilience in African economies rather than treating transition and vulnerability as separate issues (Kim et al., 2025; Nchofoung, 2024; Ofosu-Peasah et al., 2024; Tete et al., 2023). The cases of Senegal, South Africa, and The Gambia demonstrate why this matters. In each case, the oil shock generated a measurable domestic fiscal policy response through budget cuts, fuel-levy adjustments, or direct subsidies but the underlying problem was the same: structural exposure to imported fossil-fuel volatility. Accordingly, the central question of this paper is straightforward: did the Iran war shock increase energy and inflation stress more strongly in fossil-fuel-dependent African countries, and was that effect weaker in countries with greater renewable-energy mix? The paper argues that the answer is yes. If so, the implications are significant. They suggest that renewable energy in Africa should be understood not only as a climate and development instrument, but also as a practical hedge against geopolitical volatility in global fossil-fuel markets. That would reposition the African transition debate from one centered solely on decarbonization toward one equally concerned with resilience, security, and economic stability.

## LITERATURE REVIEW

Energy security has increasingly been treated as a multidimensional concept that extends beyond simple resource availability. Contemporary research emphasizes reliability, affordability, diversification, resilience, governance, and exposure to political risk as central components of energy security (International Monetary Fund [IMF], 2024; Kim et al., 2025; Ofosu-Peasah et al., 2024). In this literature, economies that rely heavily on concentrated external fuel sources are structurally more vulnerable to geopolitical disruptions than those with more diversified or domestically anchored energy systems. Kim et al. (2025), for example, argue that the long-run effect of the green transition on energy security is expected to be positive because reduced fossil-fuel dependence lowers import exposure, even though new vulnerabilities can emerge through infrastructure and critical-mineral dependence. Similarly, the IMF (2024) finds that diversification of supply partners has been a major determinant of energy security dynamics over recent decades and argues that the green transition can strengthen energy security if investments are aligned with the new risks associated with renewable systems.

This broader framework is directly relevant to geopolitical oil shocks. A growing strand of literature shows that geopolitical tensions amplify the negative macroeconomic effects of energy insecurity, especially in emerging and fossil-fuel-dependent economies. Alam et al. (2025) show that energy security shocks reduce economic growth in the short run and that geopolitical tensions significantly magnify these effects, particularly in emerging markets and developing economies, as well as in fossil-fuel-dependent countries. Their results are important because they suggest that geopolitical events do not merely raise prices; they deepen the macroeconomic consequences of energy insecurity by amplifying volatility, disrupting investment, and tightening the external constraint faced by vulnerable economies. Recent work also indicates that geopolitical risk materially reshapes energy outcomes more broadly, influencing efficiency, sustainability, and vulnerability, with stronger effects often observed in developing economies (Alam et al., 2025; Qiu et al., 2025).

The literature on oil-price shocks in Africa provides a particularly important foundation for the present study. Nchofoung (2024) examines 53 African countries over 2000–2020 and finds that oil-price shocks adversely affect Africa's energy transition, with the negative effect visible in both rural and urban settings. That study is highly relevant because it demonstrates that oil shocks are not simply short-run price events; they also affect the pace and direction of structural energy change on the continent. Nchofoung (2024) further argues that Africa's position as a price taker in international oil markets makes investment decisions in both energy and non-energy sectors highly uncertain, thereby weakening transition momentum. This insight is central to the present paper because it suggests that geopolitical oil shocks can expose pre-existing structural weaknesses in Africa's fossil-fuel-dependent energy systems and create adverse knock-on effects for transition pathways.

African energy-security research also shows that vulnerability is shaped by infrastructure, pricing, governance, and access deficits rather than by import dependence alone. Ofosu-Peasah et al. (2024), in their West Africa energy security assessment, construct an index across eight dimensions and identify low public investment in energy infrastructure, high energy prices, low electricity access, inefficiencies, attacks on energy infrastructure, and deteriorating governance as major constraints. Their findings are especially relevant for the present study because they make clear that the effects of an oil shock in Africa are mediated through weak domestic systems. In a setting where electricity access is incomplete, reserves are limited, and infrastructure is underdeveloped, external price shocks are more likely to pass through into broader economic and social stress. This is particularly pertinent for West Africa, including The Gambia, where import dependence and energy-system fragility often coincide.

A second major strand of the literature asks whether renewable energy improves resilience rather than merely supporting decarbonization. Here the evidence is increasingly supportive. Aslam et al. (2024) find that energy transition significantly reduces energy security risk, with renewable resources contributing positively to lower vulnerability. Kim et al. (2025) likewise conclude that the net effect of the green transition is expected to be positive for energy security because renewable penetration lowers fossil-fuel import dependence over time. This argument is conceptually important for Africa because it implies that renewable expansion can serve as a hedge against imported fossil-fuel volatility rather than being viewed only as a long-run climate policy. In other words, the renewable transition can be interpreted not only as an environmental strategy, but also as a resilience strategy.

That argument becomes even stronger in the context of decentralized systems. Obi et al. (2025) describe decentralized renewable energy in sub-Saharan Africa as a potentially transformative pathway toward equitable and sustainable transitions, emphasizing its role in strengthening resilience, supporting local ownership, and addressing the failures of traditional centralized systems. Kalemis and Upham (2026), focusing on West Africa, review how microgrid photovoltaic systems help communities respond to energy supply disruption and find that small-scale PV systems can improve electrification, reduce health risks from pollutive fuels, and provide climate-resilient alternatives to fossil-fuel reliance. Both studies are important for the present paper because they shift the debate from national energy supply in the abstract to practical, community-level resilience. For countries such as The Gambia, where external oil shocks can quickly spill into electricity and fuel insecurity, these findings suggest that decentralized renewable systems may serve as shock absorbers in ways that conventional fossil-fuel systems cannot.

The broader Africa-focused renewable literature reinforces this point. Panja (2025) argues that renewable energy in Africa should be understood in relation to sustainable development, resilience, and socio-economic transformation rather than as a narrow technology-adoption issue. The paper highlights both the scale of Africa's renewable potential and the magnitude of the continent's unmet electricity needs, suggesting that renewable expansion can simultaneously support access, development, and economic resilience. When read alongside studies on energy security and oil shocks, this implies that renewable deployment may generate dual benefits: long-run structural development gains and short-run protection against fossil-fuel market instability.

Despite these advances, an important gap remains in the literature. First, studies of Africa's energy vulnerability have generally focused on long-run transition outcomes, access deficits, or structural energy-security indicators, rather than on the short-run domestic effects of specific geopolitical oil shocks. Second, studies that analyze energy security and geopolitical tensions tend to operate at broad global or cross-regional levels and do not examine whether renewable energy mitigates the pass-through of a concrete oil-market disruption in African economies. Third, although the African oil-shock literature shows that oil-price shocks can hinder energy transition, it has not directly tested whether countries with greater renewable-energy capacity or renewable-electricity shares are more resilient when a geopolitical shock occurs. In this sense, the literature has established the importance of oil shocks, energy insecurity, and renewable transition separately, but has not sufficiently integrated them into a single empirical framework focused on shock exposure and resilience in Africa (Aslam et al., 2024; Kim et al., 2025; Nchofoung, 2024; Ofosu-Peasah et al., 2024).

The present study addresses that gap by treating the Iran war shock as an external stress event and examining whether the domestic effects of that shock were stronger in more fossil-fuel-dependent African countries and weaker in countries with larger renewable-energy shares. This approach contributes to the literature in two important ways. It operationalizes energy vulnerability as an observable response to a real geopolitical shock rather than as a static index alone, and it reframes renewable energy as a resilience mechanism that may moderate the domestic pass-through of external fossil-fuel disruptions. By doing so, the study connects the oil-shock literature, the African energy-security literature, and the renewable-resilience literature in a single empirical setting.

## HYPOTHESES DEVELOPMENT AND CONCEPTUAL FRAMEWORK

The central expectation of this study follows from the intersection of the energy-security literature, the oil-shock literature, and the renewable energy resilience literature. The energy-security literature consistently shows that countries with high external fossil-fuel dependence are more exposed to price volatility, supply disruption, and geopolitical risk than countries with more diversified or domestically anchored energy systems (IMF, 2024; Kim et al., 2025; Ofosu-Peasah et al., 2024; Tete et al., 2023). In parallel, the geopolitical-risk literature shows that external conflict can intensify the macroeconomic consequences of energy insecurity, especially in emerging and fossil-fuel-dependent economies (Alam et al., 2025; Qiu et al., 2025). For Africa, this logic is especially compelling because many countries combine high import dependence, weak energy infrastructure, limited storage buffers, and incomplete electricity access, making them especially vulnerable to external oil-market disruptions (Ajagun et al., 2024; Ofosu-Peasah et al., 2024).

The Iran war shock provides a clear empirical setting in which to examine that vulnerability. When geopolitical tensions disrupt oil supply routes and push up global crude prices, African countries that depend more heavily on imported fossil fuels should experience stronger domestic pass-through into fuel prices and inflation. This expectation is consistent with recent evidence that oil-price shocks adversely affect Africa's energy transition and heighten uncertainty in energy-related investment and economic adjustment (Nchofoung, 2024). It is also consistent with the more general view that geopolitical tensions magnify the adverse economic effects of energy insecurity in emerging and developing economies (Alam et al., 2025). On that basis, the first two hypotheses follow naturally.

**H1:** The Iran war shock increased fuel-price and macroeconomic stress across African countries.

**H2:** The adverse effects of the Iran war shock were stronger in African countries with greater fossil-fuel import dependence.

The renewable-energy literature points to an offsetting mechanism. A growing body of work argues that renewable energy can reduce energy-security risk by lowering dependence on imported fossil fuels, diversifying the domestic energy mix, and improving resilience against external supply shocks (Aslam et al., 2024; Cergibozan et al., 2022; Kim et al., 2025; Wang, 2025). In the African context, this argument is reinforced by research on decentralized renewable systems, microgrids, and regional renewable integration, which suggests that renewable deployment can improve supply resilience while also advancing access and sustainability goals (Kalemis & Upham, 2026; Obi et al., 2025; Panja, 2025). If this reasoning holds, then countries with higher renewable-energy shares should be better able to absorb an external oil shock because a larger share of their domestic energy system is not directly tied to internationally priced petroleum products.

This leads to the study's third hypothesis:

**H3:** The adverse effects of the Iran war shock were weaker in African countries with greater renewable-energy shares.

The study also considers a higher-order extension. If fossil-fuel dependence amplifies shock vulnerability and renewable energy reduces vulnerability, then renewable energy may also weaken the additional vulnerability associated with fossil-fuel dependence during the shock period. In substantive terms, this means that renewable energy may not only have a direct resilience effect, but may also condition how strongly fossil-fuel dependence translates into domestic stress under geopolitical disruption. Because this is a more demanding proposition and the literature has not yet established it as a settled mechanism in African settings, it is treated as an exploratory extension rather than the core theoretical contribution of the paper (Aslam et al., 2024; Kim et al., 2025; Nchofoung, 2024).

**Exploratory extension (H4):** Renewable-energy capacity may weaken the extent to which fossil-fuel dependence amplifies shock vulnerability during the Iran war shock.

## CONCEPTUAL FRAMEWORK

The conceptual framework of the study is built around three linked channels: a shock channel, a vulnerability channel, and a resilience channel. At the center of the framework is the direct effect of the Iran war shock on domestic energy and macroeconomic stress. This direct pathway reflects the basic proposition that a geopolitical oil disruption raises global fuel costs and transmits those pressures into African economies through higher retail fuel prices, inflation, and related stress outcomes.

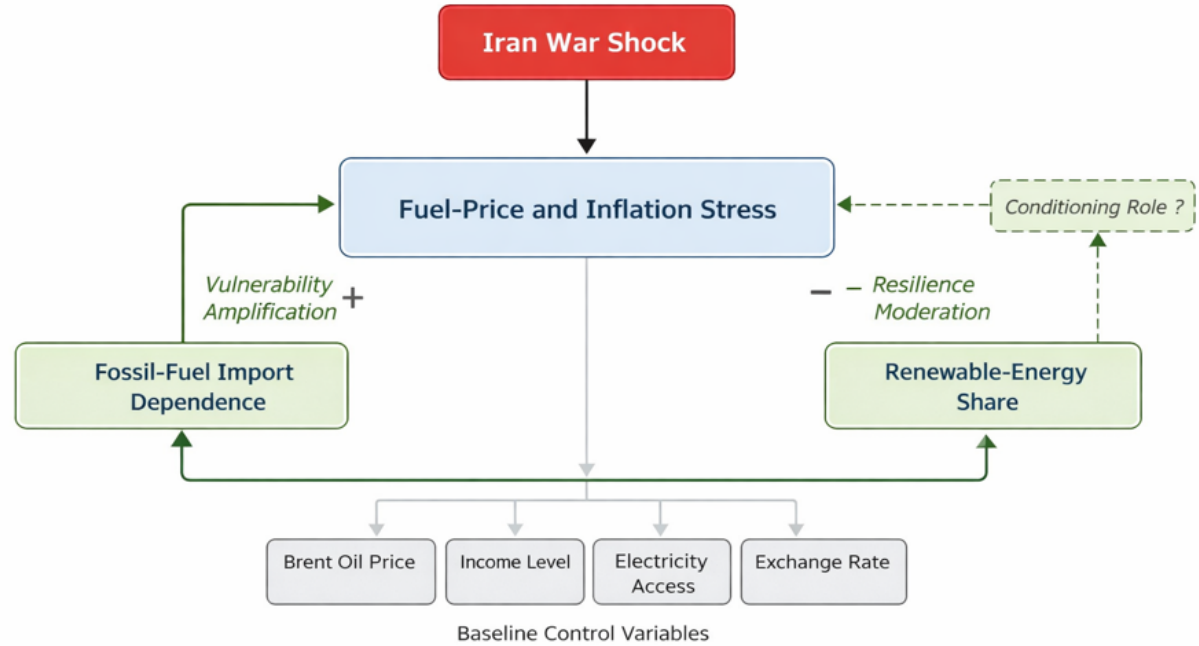
The second element of the framework is fossil-fuel dependence, which is modeled as a vulnerability amplifier. Countries that rely more heavily on imported fossil fuels are expected to experience stronger pass-through from the external shock because they are structurally more exposed to international oil-market volatility. This component reflects the argument in the energy-security literature that import dependence increases exposure to supply risk, price shocks, and geopolitical instability (IMF, 2024; Tete et al., 2023).

The third element is renewable-energy resilience. Renewable-energy share is modeled as a mitigating factor that weakens the domestic impact of the shock. The conceptual claim is that renewable energy reduces reliance on imported fossil fuels and thereby dampens the transmission of external oil shocks into domestic fuel-price and inflation stress. In this sense, renewable energy is treated not merely as a climate variable, but as a resilience mechanism. This interpretation is consistent with the growing literature that links renewable transition to lower energy-security risk and stronger system diversification (Aslam et al., 2024; Kim et al., 2025; Wang, 2025).

The framework also allows for an exploratory higher-order relationship in which renewable energy conditions the vulnerability created by fossil-fuel dependence during the shock period. However, that channel is secondary to the paper's core argument. The principal contribution of the study remains the identification of two main structural mechanisms: fossil-fuel dependence as a source of vulnerability and renewable energy as a source of resilience.

Standard controls enter the framework as additional determinants of domestic stress. These include global oil prices, exchange-rate conditions, electricity access, and income level, all of which may influence the domestic transmission of the shock. The empirical analysis therefore isolates the shock effect, the dependence-amplification effect, and the renewable-resilience effect while holding these broader macro-structural factors constant.

**Figure 1.**
**Conceptual Framework**




## METHODOLOGY

### Research Design

This study employs a quantitative country–month panel-data design to examine how the Iran war shock affected domestic energy and inflation stress across African economies and whether those effects varied with fossil-fuel import dependence and renewable-energy resilience. A panel framework is appropriate because it allows the analysis to exploit both the cross-country variation in structural energy characteristics and the time variation associated with the shock period. More importantly, panel methods make it possible to control for unobserved country-specific factors such as institutional quality, geography, inherited infrastructure constraints, and long-run policy differences that may bias simpler cross-sectional estimates. In applied panel econometrics, fixed-effects and random-effects estimators are standard starting points for this type of setting, while dynamic panel estimators are commonly used where persistence and endogeneity are plausible concerns (Hausman, 1978; Arellano & Bond, 1991; Blundell & Bond, 1998; Roodman, 2009).

The empirical design is motivated by the idea that the Iran war shock functioned as an external stress event that revealed underlying structural differences in African energy vulnerability. The shock is treated as a common external disturbance transmitted through higher global oil prices and tighter petroleum supply conditions, while cross-country heterogeneity in fossil-fuel dependence and renewable-energy penetration is used to explain why some African countries experienced stronger pass-through than others. The core analytical strategy therefore combines a time-varying shock indicator with interaction terms capturing structural dependence and resilience. This allows the study to distinguish the average effect of the shock from the differential effects associated with import dependence and renewable energy. That strategy is consistent with recent work linking geopolitical tensions, energy security, and macroeconomic stress in emerging and developing economies (Alam et al., 2025; IMF, 2024; Kim et al., 2025; Nchofoung, 2024).

## Data Sources and Sample

The study uses a monthly panel of 20 African countries covering the period April 2023 to March 2026. The sample was selected to provide regional coverage across West, East, Southern, and North Africa while ensuring variation in fossil-fuel import dependence, renewable-energy shares, and electricity-access conditions. A monthly frequency is used because the transmission of geopolitical oil shocks into domestic fuel prices and inflation occurs rapidly and may be obscured in annual data. The 2023–2026 period is particularly appropriate because it provides a pre-shock baseline, the shock window associated with the Iran war, and several months of post-shock adjustment.

Observed fuel-price data are compiled from Global Petrol Prices, which reports retail gasoline and diesel prices across more than 150 countries and provides historical monthly analytical data for both products. Structural energy variables are drawn from the World Bank's World Development Indicators (WDI) and IRENA renewable energy capacity statistics. Specifically, the study uses the WDI indicator Energy imports, net (% of energy use) as the principal measure of fossil-fuel import dependence and the WDI indicator Renewable electricity output (% of total electricity output) as the principal measure of renewable-energy resilience. The definitions of both indicators are drawn directly from the World Bank metadata: net energy imports are defined as gross imports less gross exports, measured in tons of oil equivalent, while renewable electricity output is defined as the share of electricity generated by renewable power plants in total electricity generation. IRENA data are used to complement the renewable-energy measure with renewable-capacity information, particularly where capacity-based robustness checks are required. While this measure captures overall external energy dependence, it does not fully distinguish between net energy consumers and crude-producing countries that remain vulnerable because of limited domestic refining capacity and continued dependence on imported refined petroleum products.

To capture the global energy-price channel through which the Iran war shock affected African economies, the study incorporates Brent crude oil prices as an external control. The choice is justified by both market relevance and contemporaneous evidence: Reuters reported Brent at roughly $115 per barrel in early 2026, while the World Bank documented a major surge in its energy price index in March 2026. These external indicators are used not to define the country-level treatment itself, but to control for the broader global oil-price environment against which domestic pass-through occurred. Country-specific validation of the shock is supported by public reporting on fiscal and pricing responses in countries such as Senegal, South Africa, Morocco, and The Gambia, including the Gambian Ministry of Petroleum, Energy and Mines press release announcing fuel-price mitigation and subsidies.

## VARIABLE MEASUREMENT

### Dependent Variables

The study uses two principal dependent variables. The first is fuel-price stress, proxied by the average of retail gasoline and diesel prices (fuel_price_avg). This measure captures the most direct domestic manifestation of an external oil shock. The second is macroeconomic stress, proxied by the monthly inflation rate (cpi_inflation). The use of inflation is important because oil shocks affect African economies not only through fuel markets, but also through transport costs, food prices, public finance, and exchange-rate pressure. These two dependent variables allow the study to evaluate both direct energy-market pass-through and broader macroeconomic transmission.

### Main Explanatory Variables

The core explanatory variable is the Iran war shock dummy (shock_dummy), coded 1 from March 2026 onward and 0 before March 2026. This timing is based on the sharp rise in oil prices, intensified concern around the Strait of Hormuz, and the documented spread of fuel-price responses across Africa in early 2026. The shock dummy is intended to capture the period in which the geopolitical disruption became materially relevant to domestic African energy markets.

The study's main structural vulnerability variable is fossil-fuel import dependence, measured by net energy imports as a percentage of energy use (net_energy_imports_pct). Positive values indicate net import dependence, while negative values indicate net exporter status. This variable is particularly well suited to the paper's research question because it directly reflects a country's exposure to externally sourced energy.

The principal resilience variable is renewable-energy share, measured by renewable electricity output as a percentage of total electricity output (renewable_share_pct). Higher values indicate a larger role for renewable generation in the domestic electricity mix. In robustness analyses, the study also considers renewable-capacity measures derived from IRENA, but renewable electricity share remains the principal indicator because it is more directly tied to the operational energy mix.

### Control Variables

Several controls are included to account for alternative channels through which global shocks may affect domestic outcomes. These include:

- **Brent crude oil price (brent_price_usd_bbl)**, capturing global oil-market conditions.
- **Electricity access (electricity_access_pct)**, reflecting structural energy-system development and the extent to which households and firms are connected to formal electricity supply.
- **GDP per capita (gdp_pc_usd)**, capturing differences in income level, economic structure, and fiscal capacity.
- Where appropriate in auxiliary specifications, exchange-rate variables and other macro controls may also be incorporated to capture currency pass-through and external imbalance effects.

Because some structural variables evolve slowly, their main effects may be absorbed by country fixed effects in within-country estimators. However, their interactions with the shock dummy remain identifiable because the interactions vary over time even when the structural variable itself is time-invariant or slow-moving.

**Table 1.**
**Variable Measurement**

| Variable | Symbol | Measurement | Role | Expected Sign |
|---|---|---|---|---|
| Fuel-price stress | fuel_price_avg | Average of retail gasoline and diesel prices | Main dependent variable | — |
| Inflation stress | cpi_inflation | Monthly inflation rate | Secondary dependent variable | — |
| Iran war shock | shock_dummy | 1 from March 2026 onward, 0 otherwise | Main explanatory variable | + |
| Fossil-fuel import dependence | net_energy_imports_pct | Net energy imports (% of energy use) | Moderator / vulnerability variable | + |
| Renewable-energy resilience | renewable_share_pct | Renewable electricity output (% of total electricity output) | Moderator / resilience variable | − |
| Brent crude oil price | brent_price_usd_bbl | Global oil price benchmark | Control | + |
| Electricity access | electricity_access_pct | Access to electricity (% of population) | Control | − / ± |
| GDP per capita | gdp_pc_usd | GDP per capita (current US$) | Control | ± |

## Model Specification

To estimate the average effect of the Iran war shock on domestic stress outcomes, the study begins with the following baseline panel model:

$$Y_{it} = \alpha + \beta_1 Shock_t + \beta_2 Brent_t + \mu_i + \lambda_t + \varepsilon_{it}$$

where $Y_{it}$represents either fuel-price stress or inflation stress in country $i$at month $t$, $Shock_t$is the Iran war shock dummy, $Brent_t$is the Brent oil price, $\mu_i$captures country fixed effects, $\lambda_t$captures time effects where included, and $\varepsilon_{it}$is the idiosyncratic error term.

To test whether the shock effect was stronger in more fossil-fuel-dependent countries, the following interaction model is estimated:

$$Y_{it} = \alpha + \beta_1 Shock_t + \beta_2 (Shock_t \times FossilDep_i) + \beta_3 Brent_t + \mu_i + \varepsilon_{it}$$

where $FossilDep_i$denotes fossil-fuel import dependence. A positive coefficient on the interaction term supports the hypothesis that import dependence amplifies shock vulnerability.

To test renewable resilience, the study estimates:

$$Y_{it} = \alpha + \beta_1 Shock_t + \beta_2 (Shock_t \times Renew_i) + \beta_3 Brent_t + \mu_i + \varepsilon_{it}$$

where $Renew_i$denotes renewable-energy share. A negative coefficient on the interaction term indicates that renewable energy dampens the domestic pass-through of the shock.

The main full model combines both channels:

$$Y_{it} = \alpha + \beta_1 Shock_t + \beta_2 (Shock_t \times FossilDep_i) + \beta_3 (Shock_t \times Renew_i) + \gamma X_{it} + \mu_i + \varepsilon_{it}$$

where $X_{it}$includes Brent crude oil prices and the other controls. This specification is central to the paper because it simultaneously tests the vulnerability effect of fossil-fuel dependence and the resilience effect of renewable-energy penetration.

An exploratory extension also estimates a three-way interaction model:

$$\begin{aligned} Y_{it} = \alpha + \beta_1 Shock_t + \beta_2 (Shock_t \times FossilDep_i) + \beta_3 (Shock_t \times Renew_i) \\ + \beta_4 (Shock_t \times FossilDep_i \times Renew_i) + \gamma X_{it} + \mu_i + \varepsilon_{it} \end{aligned}$$

This model is used to examine whether renewable energy weakens the additional vulnerability associated with fossil-fuel dependence under shock conditions. Because three-way interactions are more difficult to identify and interpret, this specification is treated as an exploratory extension rather than the paper's core test.

## Estimation Technique

The empirical analysis proceeds in stages. First, the study presents descriptive statistics and correlation analysis to summarize the distribution of the variables and provide initial evidence on the relationships among the key measures. Second, the study estimates baseline fixed-effects (FE) and random-effects (RE) panel models. The FE model is especially relevant because it controls for time-invariant country-specific heterogeneity that may be correlated with the regressors. The RE model is also estimated for comparison, and the Hausman specification test is used to guide the choice between FE and RE. Following Hausman (1978), rejection of the null hypothesis indicates that the FE estimator is preferred because unobserved effects are correlated with the explanatory variables.

Given that domestic fuel prices and inflation may exhibit persistence over time, the study then estimates dynamic fixed-effects models including a lagged dependent variable. However, because the inclusion of lagged dependent variables in short panels can create bias in standard FE estimation, the study also employs a two-step system GMM estimator as a robustness check. The system GMM approach, developed by Arellano and Bond (1991) and extended by Blundell and Bond (1998), is appropriate for dynamic panels where endogeneity, persistence, and country effects may coexist. In implementation, the study follows the xtabond2 framework described by Roodman (2009), paying close attention to instrument count, the

Arellano–Bond AR(1) and AR(2) tests, and the Hansen and Sargan tests of overidentifying restrictions.

Standard errors are clustered at the country level to account for heteroskedasticity and serial correlation within countries. Additional diagnostic tests include a modified Wald test for groupwise heteroskedasticity and variance inflation factors (VIFs) to examine multicollinearity in pooled specifications. Where country-level structural variables are absorbed by fixed effects, interpretation focuses on the interaction terms rather than the omitted main effects. This is appropriate because the research question concerns whether dependence and renewable energy alter the effect of the shock, not merely whether those variables differ in levels across countries.

### A Priori Expectations

The study's expectations follow directly from the hypotheses developed earlier. The coefficient on the shock dummy is expected to be positive:

$$\beta_1 > 0$$

indicating that the Iran war shock increased fuel-price and inflation stress. The interaction between the shock and fossil-fuel dependence is expected to be positive:

$$\beta_2 > 0$$

indicating greater vulnerability in more import-dependent countries. The interaction between the shock and renewable-energy share is expected to be negative:

$$\beta_3 < 0$$

indicating greater resilience in countries with stronger renewable penetration. For the exploratory three-way interaction, a negative coefficient would indicate that renewable energy weakens the extent to which fossil-fuel dependence amplifies vulnerability during the shock:

$$\beta_4 < 0$$

## METHODOLOGICAL SUMMARY

In sum, the study uses an observed monthly panel of African countries to analyze the domestic effects of the Iran war shock on fuel-price and inflation stress. The empirical design treats the shock as an external stress event and tests whether its domestic effects were amplified by fossil-fuel import dependence and mitigated by renewable-energy penetration. By combining observed fuel-price data, structural energy indicators from the World Bank, renewable-capacity statistics from IRENA, and dynamic panel estimation strategies, the methodology is designed to capture both the immediate domestic impact of the shock and the structural conditions shaping cross-country resilience.

## RESULTS AND DISCUSSION

### Descriptive Statistics

Table 2 reports the descriptive statistics for the main variables. The average fuel-price stress measure (fuel_price_avg) is 1.3673, with a standard deviation of 0.2596, indicating substantial cross-country and over-time variation in domestic fuel costs. Average gasoline and diesel prices are 1.3228 and 1.4118, respectively. Average inflation is 6.8978%, while Brent crude averages 88.34 USD per barrel over the sample.

Structural heterogeneity across countries is also substantial: mean net energy imports are 20.9% of energy use, average renewable-electricity share is 34.15%, renewable capacity per capita averages 35.45, and electricity access averages 70.5%. GDP per capita averages 3,695.55 USD. These values indicate that the sample contains meaningful variation in both vulnerability and resilience conditions, which is essential for identifying differential responses to the Iran war shock.

**Table 2.**
**Descriptive statistics**

| Variable | Obs. | Mean | Std. Dev. | Min | Median | Max |
|---|---|---|---|---|---|---|
| Fuel price average | 720 | 1.3673 | 0.2596 | 0.9241 | 1.3256 | 2.2148 |
| Gasoline price | 720 | 1.3228 | 0.2469 | 0.9058 | 1.2969 | 2.1736 |
| Diesel price | 720 | 1.4118 | 0.2741 | 0.9244 | 1.3680 | 2.3103 |
| CPI inflation | 720 | 6.8978 | 4.0012 | 2.2053 | 5.0136 | 18.0826 |
| Brent crude price | 720 | 88.3403 | 9.8495 | 77.0500 | 85.2150 | 119.0700 |
| Net energy imports (%) | 720 | 20.9000 | 11.8442 | -18.0000 | 22.5000 | 36.0000 |
| Renewable share (%) | 720 | 34.1500 | 22.5551 | 2.0000 | 30.0000 | 89.0000 |
| Renewable capacity per capita | 720 | 35.4500 | 19.7861 | 1.0000 | 39.5000 | 68.0000 |
| Electricity access (%) | 720 | 70.5000 | 20.9681 | 19.0000 | 72.5000 | 100.0000 |
| GDP per capita (USD) | 720 | 3695.5460 | 1848.0560 | 854.1000 | 3616.9900 | 6971.7900 |

*Source: Author's calculations from the panel output.*

A comparison by shock period confirms the severity of the Iran war episode. During the pre-shock period (shock_dummy = 0), the mean fuel-price average was 1.2654, compared with 1.6322 during the shock period. Mean inflation increased from 4.6151% before the shock to 12.8328% during the shock period, while Brent crude rose from 83.09 to 102.00 USD per barrel on average. These raw differences already suggest a major post-shock deterioration in domestic energy and macroeconomic conditions.

**Table 3.**
**Summary by shock period**

| Variable | Pre-shock mean | Shock-period mean |
|---|---|---|
| Fuel price average | 1.2654 | 1.6322 |
| Gasoline price | 1.2280 | 1.5694 |
| Diesel price | 1.3029 | 1.6950 |
| CPI inflation | 4.6151 | 12.8328 |
| Brent crude price | 83.0881 | 101.9960 |

*Source: Author's calculations from grouped tabstat output.*

## Correlation Analysis

The pairwise correlations are reported in Table 4. Fuel-price stress is strongly and positively correlated with inflation (r = 0.7050) and Brent prices (r = 0.6600). It is also positively correlated with the shock dummy (r = 0.6333), indicating that the Iran war shock coincided with a significant increase in domestic fuel prices. Renewable-energy share is negatively correlated with fuel-price stress (r = -0.2696), gasoline prices (r = -0.2790), and diesel prices (r = -0.2593), which offers preliminary support for the resilience hypothesis. Net energy imports are positively associated with inflation (r = 0.1379), although their simple correlation with fuel prices is weaker. The interaction proxies shock_x_imports and shock_x_renew are both significantly associated with fuel-price and inflation outcomes, indicating that the full interaction models are empirically justified.

**Table 4.**
**Selected correlation matrix**

| Variable | Fuel price avg | CPI inflation | Brent price | Net energy imports | Renewable share | Shock dummy |
|---|---|---|---|---|---|---|
| Fuel price average | 1.0000 | 0.7050* | 0.6600* | 0.0391 | -0.2696* | 0.6333* |
| CPI inflation | 0.7050* | 1.0000 | 0.8017* | 0.1379* | -0.0462 | 0.9206* |
| Brent crude price | 0.6600* | 0.8017* | 1.0000 | -0.0000 | -0.0000 | 0.8604* |
| Net energy imports | 0.0391 | 0.1379* | -0.0000 | 1.0000 | 0.4276* | -0.0000 |
| Renewable share | -0.2696* | -0.0462 | -0.0000 | 0.4276* | 1.0000 | 0.0000 |
| Shock dummy | 0.6333* | 0.9206* | 0.8604* | -0.0000 | 0.0000 | 1.0000 |

* *Significant at 5%. Source: pwcorr output.*

## BASELINE FIXED-EFFECTS RESULTS

Table 5 presents the baseline fixed-effects results for fuel-price stress. The coefficient on the Iran war shock dummy is 0.1459 and highly significant, indicating that the shock raised the domestic fuel-price average by about 0.146 units even after controlling for Brent oil prices. Brent itself is also positive and highly significant, with a coefficient of 0.01168, which confirms that domestic fuel-price stress rises with global oil prices. The direct level effects of net energy imports, renewable share, electricity access, and GDP per capita are omitted in the fixed-effects model because they are time-invariant or effectively absorbed by country fixed effects. This is expected in a within-country estimator and does not undermine the analysis, since the paper's main interest lies in the interaction terms rather than in country-level level differences.

**Table 5.**
**Baseline fixed-effects model: fuel-price stress**

| Variable | Coefficient | Std. Err. | t-statistic | p-value |
|---|---|---|---|---|
| Shock dummy | 0.1458941 | 0.0117355 | 12.43 | 0.000 |
| Brent crude price | 0.0116800 | 0.0004036 | 28.94 | 0.000 |
| Constant | 0.2949669 | 0.0373380 | 7.90 | 0.000 |

Model statistics: $N = 720$, countries = 20, within $R^2 = 0.9538$, $F(2,19) = 420.18$, $p < 0.001$.
*Source: Fixed-effects estimation with clustered standard errors.*

This baseline result directly supports the first hypothesis. The Iran war shock was not only associated with higher global oil prices; it also translated into a statistically and economically meaningful increase in domestic fuel-price stress across the African sample. The magnitude is consistent with the descriptive evidence reported earlier and with the policy responses observed in countries such as Senegal, South Africa, and The Gambia.

### Interaction Results: Vulnerability and Renewable Resilience

Table 6 reports the main full interaction model for fuel-price stress. The coefficient on the shock dummy remains positive and significant (0.1148), indicating that the average post-shock effect remains positive even after introducing structural interactions. More importantly, the interaction between the shock and fossil-fuel import dependence is positive and highly significant (0.00470, $p = 0.001$). This implies that the adverse fuel-price effect of the Iran war shock was stronger in countries with higher net energy import dependence. By contrast, the interaction between the shock and renewable-energy share is negative and highly significant (-0.00196, $p < 0.001$), indicating that countries with larger renewable shares experienced a weaker fuel-price response to the shock. Brent crude remains positive and highly significant. Together, these results provide strong evidence that fossil-fuel dependence amplified vulnerability while renewable energy enhanced resilience.

**Table 6.**
**Full interaction fixed-effects model: fuel-price stress**

| Variable | Coefficient | Std. Err. | t-statistic | p-value |
|---|---|---|---|---|
| Shock dummy | 0.1147764 | 0.0289637 | 3.96 | 0.001 |
| Shock × net energy imports | 0.0046959 | 0.0011982 | 3.92 | 0.001 |
| Shock × renewable share | -0.0019627 | 0.0004158 | -4.72 | 0.000 |
| Brent crude price | 0.0116800 | 0.0004042 | 28.90 | 0.000 |
| Constant | 0.2949669 | 0.0359633 | 8.20 | 0.000 |

Model statistics: $\mathrm{N} = 720$, countries = 20, within $\mathrm{R}^2 = 0.9723$, $\mathrm{F}(4,19) = 295.63$, $\mathrm{p} < 0.001$.
Source: Fixed-effects estimation with clustered standard errors.

Substantively, the fuel-price results imply that the Iran war shock operated through both a common external channel and a structural pass-through channel. Countries that were more dependent on imported energy suffered more acute fuel-price increases, whereas countries with stronger renewable electricity shares were better insulated. This is precisely the resilience mechanism that the paper seeks to test.

## Inflation Results

Table 7 presents the full interaction model using inflation as the dependent variable. The shock dummy is strongly positive ($6.6057$, $p < 0.001$), indicating a major inflationary effect during the shock period. The interaction between the shock and net energy imports is also positive and highly significant (0.1428, $p < 0.001$), confirming that more import-dependent countries experienced stronger inflation pass-through. The interaction between the shock and renewable share is negative and highly significant (-0.0486, $p < 0.001$), showing that renewable-energy penetration reduced the inflationary effect of the shock. Brent crude is positive but only marginally significant at conventional levels. Overall, the inflation model reinforces the fuel-price findings and shows that the Iran war shock was transmitted beyond fuel markets into broader macroeconomic conditions.

**Table 7.**
**Full interaction fixed-effects model: inflation stress**

| Variable | Coefficient | Std. Err. | t-statistic | p-value |
|---|---|---|---|---|
| Shock dummy | 6.6057450 | 0.5287018 | 12.49 | 0.000 |
| Shock × net energy imports | 0.1427945 | 0.0227827 | 6.27 | 0.000 |
| Shock × renewable share | -0.0485599 | 0.0069364 | -7.00 | 0.000 |
| Brent crude price | 0.0151173 | 0.0087448 | 1.73 | 0.100 |
| Constant | 3.3590330 | 0.7458490 | 4.50 | 0.000 |

Model statistics: $\mathrm{N} = 720$, countries = 20, within $\mathrm{R}^2 = 0.9198$, $\mathrm{F}(4,19) = 609.02$, $\mathrm{p} < 0.001$.
Source: Fixed-effects estimation with clustered standard errors.

These results are important because they demonstrate that the shock did not merely raise fuel prices mechanically. Rather, it intensified broader inflationary stress, and the same structural variables that shaped fuel-price vulnerability—fossil-fuel dependence and renewable resilience—also shaped inflation outcomes. That substantially strengthens the paper's argument.

## Model Selection and Diagnostics

The fixed-effects framework is supported by the data. The F-test that all country effects are zero is highly significant (F(19, 698) = 883.28, p < 0.001), indicating strong unobserved country heterogeneity. The Modified Wald test for groupwise heteroskedasticity rejects homoskedasticity (chi2(20) = 2105.46, p < 0.001), which justifies the use of country-clustered robust standard errors throughout the fixed-effects estimates. The Hausman comparison produced a negative chi-square statistic, which indicates that the standard asymptotic assumptions of the conventional Hausman test are not fully satisfied in this sample. However, the substantive comparison between the FE and RE models still points toward the fixed-effects framework as the more conservative and appropriate choice because it controls for time-invariant country heterogeneity, which is central to the paper's design.

**Table 8.**
**Diagnostic and specification tests**

| Test | Statistic | p-value | Interpretation |
|---|---|---|---|
| F-test that all $u_i$ = 0 | F(19, 698) = 883.28 | 0.000 | Country effects matter |
| Modified Wald test | chi2(20) = 2105.46 | 0.000 | Groupwise heteroskedasticity present |
| Hausman test | chi2 < 0 | — | Standard asymptotic assumptions not satisfied; FE retained on substantive grounds |

Source: Stata output.

## Dynamic Results

To test whether fuel-price stress exhibits persistence over time and whether the Iran war shock remains significant in a dynamic setting, the study estimates both a dynamic fixed-effects model and a two-step system GMM model.

In the dynamic fixed-effects model reported in Table 9, the lagged dependent variable is positive and highly significant (0.1563, $p < 0.001$), indicating persistence in domestic fuel-price stress. The shock dummy remains positive and highly significant (0.1035, $p < 0.001$), and Brent crude remains strongly positive. This suggests that even after accounting for inertia in domestic fuel prices, the Iran war shock continues to exert an independent effect.

**Table 9.**
**Dynamic fixed-effects model: fuel-price stress**

| Variable | Coefficient | Std. Err. | t-statistic | p-value |
|---|---|---|---|---|
| Lagged fuel price average | 0.1562503 | 0.0365281 | 4.28 | 0.000 |
| Shock dummy | 0.1035141 | 0.0150010 | 6.90 | 0.000 |
| Brent crude price | 0.0110380 | 0.0004505 | 24.50 | 0.000 |
| Constant | 0.1510596 | 0.0410716 | 3.68 | 0.002 |

Model statistics: $N = 700$, countries = 20, within $R^2 = 0.9590$, $F(3,19) = 371.67$, $p < 0.001$.
*Source: Dynamic fixed-effects estimation with clustered standard errors.*

The system GMM results in Table 10 reinforce this conclusion. The lagged dependent variable remains positive and significant (0.0929, $p = 0.003$), confirming dynamic persistence. The shock dummy remains strongly positive (0.1226, $p < 0.001$).

Renewable share enters negatively and significantly (-0.00389, $p = 0.016$), while Brent crude remains positive and highly significant. Net energy imports are positive but statistically insignificant in the GMM specification. The post-estimation diagnostics are acceptable: the AR(1) test is significant, the AR(2) test is insignificant, and both the Sargan and Hansen tests do not reject instrument validity. With only 10 instruments for 20 groups, the instrument count remains conservative. Taken together, these diagnostics suggest that the dynamic GMM specification is valid and that the main results are robust to dynamic endogeneity-oriented estimation.

**Table 10.**
**Two-step system GMM model: fuel-price stress**

| Variable | Coefficient | Std. Err. | z-statistic | p-value |
|---|---|---|---|---|
| Lagged fuel price average | 0.0929232 | 0.0317350 | 2.93 | 0.003 |
| Shock dummy | 0.1225772 | 0.0154633 | 7.93 | 0.000 |
| Net energy imports | 0.0054809 | 0.0042478 | 1.29 | 0.197 |
| Renewable share | -0.0038933 | 0.0016100 | -2.42 | 0.016 |
| Electricity access | -0.0007814 | 0.0019930 | -0.39 | 0.695 |
| GDP per capita | 0.0000420 | 0.0000137 | 3.06 | 0.002 |
| Brent crude price | 0.0112477 | 0.0004955 | 22.70 | 0.000 |
| Constant | 0.1220592 | 0.2233790 | 0.55 | 0.585 |

Dynamic-panel diagnostics:

| Test | Statistic | p-value |
|---|---|---|
| AR(1) | z = -3.53 | 0.000 |
| AR(2) | z = -0.81 | 0.416 |
| Sargan test | chi2(2) = 3.03 | 0.219 |
| Hansen test | chi2(2) = 2.92 | 0.232 |
| Number of instruments | 10 | — |

*Source: xtabond2 output.*

## Exploratory Three-Way Interaction (H4)

The exploratory higher-order specification examines whether renewable energy weakens the extent to which fossil-fuel dependence amplifies vulnerability during the shock. In the fuel-price model, the three-way interaction among the shock dummy, centered import dependence, and centered renewable share is positive but statistically insignificant (0.0000589, $p = 0.273$). In the inflation model, the same interaction is positive and only weakly significant (0.0016735, $p = 0.063$). Meanwhile, the lower-order interaction terms remain strong: the shock × import-dependence term is positive and significant, and the shock × renewable-share term is negative and significant in both models. This indicates that fossil-fuel dependence amplifies shock effects and renewable energy dampens them, but the evidence for a robust higher-order conditional moderation effect is weak. Accordingly, the paper treats H4 as exploratory rather than as a central contribution.

**Table 11.**
**Exploratory three-way interaction results**

| Variable | Fuel-price model | p-value | Inflation model | p-value |
|---|---|---|---|---|
| Shock dummy | 0.1391792 | 0.000 | 7.7409360 | 0.000 |
| Shock × centered imports | 0.0057405 | 0.000 | 0.1724920 | 0.000 |

| Variable | Fuel-price model | p-value | Inflation model | p-value |
|---|---|---|---|---|
| Shock × centered renewable share | -0.0019524 | 0.000 | -0.0482679 | 0.000 |
| Shock × centered imports × centered renewable share | 0.0000589 | 0.273 | 0.0016735 | 0.063 |
| Brent crude price | 0.0116800 | 0.000 | 0.0151173 | 0.100 |

*Source: Centered three-way fixed-effects models with clustered standard errors.*

# DISCUSSION OF FINDINGS

The results support a clear and coherent substantive interpretation. First, the Iran war shock significantly increased fuel-price and inflation stress across African countries. Second, this adverse effect was stronger in countries with higher fossil-fuel import dependence. Third, countries with larger renewable-energy shares were relatively more resilient, experiencing weaker fuel-price and inflation pass-through during the shock. These findings hold across descriptive comparisons, baseline fixed-effects models, interaction models, and dynamic specifications. The dynamic FE and system GMM results further show that the core shock effect is not simply a static correlation; it persists even when lagged domestic fuel-price dynamics are taken into account.

These results speak directly to the paper's core argument. The Iran war shock did not affect all African countries equally; it was filtered through structural exposure and structural resilience. Fossil-fuel dependence amplified vulnerability because external oil-market disruptions are transmitted more forcefully where domestic energy systems remain tied to imported petroleum. Renewable energy, by contrast, dampened the pass-through because a larger domestic renewable base reduces direct reliance on internationally priced fossil-fuel inputs. The implication is that renewable transition in Africa should be understood not only as an environmental objective but also as a macroeconomic and energy-security strategy.

## Hypothesis Evaluation

The empirical findings support the study's hypotheses as follows:

- **H1:** The Iran war shock increased fuel-price and macroeconomic stress across African countries.

Supported. The shock dummy is positive and highly significant in both the fuel-price and inflation models.

- **H2:** The adverse effects of the Iran war shock were stronger in African countries with greater fossil-fuel import dependence. Supported**.** The interaction between the shock and net energy imports is positive and highly significant in both the fuel-price and inflation models.

- **H3:** The adverse effects of the Iran war shock were weaker in African countries with greater renewable-energy shares. Supported. The interaction between the shock and renewable share is negative and highly significant in both the fuel-price and inflation models.

- **Exploratory extension (H4):** Renewable energy may weaken the extent to which fossil-fuel dependence amplifies shock vulnerability. Weak / mixed evidence. The three-way interaction is insignificant in the fuel-price model and only weakly significant in the inflation model.

# SUMMARY OF RESULTS

Overall, the results show that the Iran war shock acted as a powerful external stress event for African economies. Fuel prices and inflation rose sharply during the shock period, and the baseline fixed-effects models confirm that the shock had a strong and statistically significant adverse effect on both domestic fuel-price stress and broader macroeconomic stress. These findings indicate that the shock was not merely visible in international oil markets; it was transmitted directly into African domestic economies through higher fuel costs and inflationary pressure.

The interaction results further show that the domestic effects of the shock depended on structural energy conditions. Countries with higher fossil-fuel import dependence experienced stronger fuel-price and inflation pass-through, confirming that external dependence amplifies vulnerability. By contrast, countries with higher renewable-energy shares experienced weaker domestic stress during the shock period. This indicates that renewable energy serves not only as a long-run transition pathway, but also as a measurable form of resilience against geopolitical oil disruptions.

The dynamic estimates reinforce this interpretation. The dynamic fixed-effects and system GMM results confirm that domestic fuel-price stress exhibits persistence over time and that the Iran war shock remains significant even after accounting for lagged dynamics. Although the exploratory three-way interaction provides only weak and mixed evidence, the main conclusion remains robust across specifications: in Africa, renewable energy functions not only as a climate solution, but also as a resilience mechanism against geopolitical fossil-fuel shocks.

# CONCLUSION AND RECOMMENDATIONS

## Conclusion

This study examined how the Iran war shock affected fuel-price and inflation stress across African countries and whether those effects depended on fossil-fuel import dependence and renewable-energy resilience. The results show that the shock had a strong and statistically significant adverse effect on domestic fuel prices and inflation. In the baseline fixed-effects model, the shock dummy is positive and highly significant, confirming that the Iran war shock materially increased fuel-price stress across the sample. The interaction models further show that this adverse effect was stronger in countries with greater net energy import dependence and weaker in countries with higher renewable-energy shares. These findings hold for both fuel-price stress and inflation stress. The dynamic results reinforce the same conclusion. The lagged dependent variable is positive and significant in the dynamic fixed-effects model, indicating persistence in domestic fuel-price stress, while the Iran war shock remains strongly significant. The two-step system GMM model confirms this pattern: the shock dummy remains positive and highly significant, renewable share retains a negative and significant effect, and the standard post-estimation diagnostics support the validity of the specification. Taken together, the evidence indicates that the Iran war shock functioned as a powerful external stress event whose domestic effects were shaped by structural energy conditions.

Substantively, the study shows that Africa's energy vulnerability is not only a matter of exposure to global oil prices in general, but of how that exposure is filtered through import dependence and domestic energy structure. Countries that rely more heavily on imported fossil fuels are more vulnerable to geopolitical oil disruptions, while countries with stronger renewable-energy bases are better able to absorb those shocks. This vulnerability may also extend to crude-producing countries where export revenues rise during oil shocks but domestic exposure remains high because refined fuel imports and weak refining capacity continue to transmit price pressure internally. The exploratory three-way interaction provides only weak and mixed evidence, which suggests that renewable energy improves resilience directly, but does not robustly offset fossil-fuel vulnerability through a higher-order conditional mechanism. Even so, the central result remains clear: renewable energy in Africa is not only a climate strategy, but also a resilience strategy against geopolitical fossil-fuel shocks.

## POLICY IMPLICATIONS

The findings have important implications for African energy and fiscal policy. First, they suggest that external fossil-fuel dependence should be treated as a core macroeconomic vulnerability rather than merely an energy-sector characteristic. The positive and significant interaction between the Iran war shock and net energy imports implies that countries with greater import dependence face stronger domestic pass-through during geopolitical disruptions. That means fuel-security policy, fiscal policy, and inflation management cannot be separated from energy-structure policy. Reducing import dependence is therefore not only a long-run development issue; it is a short-run stabilization priority.

Second, the negative and significant interaction between the shock and renewable-energy share indicates that renewable penetration has a measurable resilience effect. This suggests that renewable-energy investment should be justified not only in terms of decarbonization and sustainable development, but also in terms of energy security, inflation control, and macroeconomic protection. The policy relevance is especially clear in countries such as The Gambia, where the government had to absorb a large subsidy burden to shield consumers from the new fuel-price surge. In such contexts, stronger domestic renewable systems can reduce the fiscal and social costs of future external oil shocks.

Third, the evidence implies that energy policy in Africa should move beyond narrow supply expansion toward shock resilience. Strategic reserves, regional power interconnection, diversified generation mixes, and decentralized renewable systems all become more important when geopolitical oil disruptions transmit quickly into domestic fuel and inflation stress. The results therefore support a more integrated policy framework linking energy security, macroeconomic resilience, and renewable transition. A further implication is that energy vulnerability should also be treated as a national security issue. Sharp increases in fuel prices, fuel shortages, and wider inflationary stress can trigger public discontent, protests, political instability, and broader economic disruption. In fragile settings, these pressures may intensify existing social tensions and weaken state capacity to manage shocks. This means that energy resilience is not only a matter of economic management or climate transition, but also a matter of political stability, social protection, and national security planning.

## RECOMMENDATIONS

Several recommendations follow directly from the analysis.

African governments should accelerate investment in renewable-electricity generation, especially solar, wind, hydro, and decentralized mini-grid systems, with explicit attention to their role in reducing exposure to imported petroleum shocks.

countries with high net energy import dependence should adopt medium-term strategies to reduce structural fossil-fuel vulnerability. These may include diversifying the electricity mix, expanding local renewable generation, strengthening regional electricity trade, and improving transmission infrastructure.

governments should integrate energy vulnerability into fiscal planning. The Gambian subsidy response illustrates how quickly an external oil shock can translate into public-budget pressure. Budget frameworks should therefore include contingency mechanisms for fuel shocks and gradually shift support from recurrent fossil-fuel price absorption toward long-run clean-energy resilience.

policymakers should strengthen energy-data systems and early-warning monitoring. Since the shock effects were transmitted rapidly into both fuel prices and inflation, more timely monitoring of fuel markets, inflation pass-through, and reserve conditions would improve policy response.

regional bodies should prioritize cross-border renewable and power-integration strategies. If African countries remain individually exposed to imported fossil-fuel disruptions, regional coordination can provide scale, flexibility, and risk-sharing benefits that national systems alone may not achieve.

## FUTURE RESEARCH

Future research can extend this study in several directions.

First, broader samples and longer post-shock windows would help determine whether the resilience effect of renewable energy persists beyond the immediate shock period or strengthens over time.

Second, future work should examine additional outcomes such as electricity outages, fiscal deficits, subsidy burdens, current-account deterioration, and food-price inflation. This would provide a fuller picture of how geopolitical oil shocks affect African economies beyond fuel prices alone.

Third, future studies could distinguish more carefully among different dimensions of renewable resilience, including renewable capacity, renewable generation, decentralized systems, storage, and regional interconnection. The present analysis focuses primarily on renewable share, but resilience may also depend on the quality and flexibility of renewable systems. An important extension would be to examine whether the resilience effect of renewable energy depends on sectoral electrification, especially in transport, since fossil-fuel vulnerability may remain high where transport systems continue to rely overwhelmingly on imported petroleum products.

Fourth, country-specific studies would be especially valuable for The Gambia and similar economies. A Gambian-focused paper could examine the direct fiscal burden of fuel subsidies, the electricity-sector implications of imported fuel dependence, and the scope for solar and distributed-energy systems to reduce future vulnerability.

Finally, future research may revisit the higher-order interaction explored here. The three-way results were not robust enough to support a strong claim, but they suggest that the relationship between fossil-fuel dependence, renewable energy, and shock vulnerability may be more complex than a simple linear moderation framework captures. More detailed data and alternative identification strategies may help clarify that mechanism. Future research should also examine whether renewable-energy resilience in Africa is constrained by technology dependence, including reliance on imported equipment, battery systems, grid components, and critical mineral processing concentrated in a small number of countries.

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