HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

THE IMPACT OF GLOBAL ENERGY MARKET TRANSFORMATION ON THE TRADE BALANCE OF PRIMARY COMMODITY EXPORTERS: EVIDENCE FROM BRICS+ COUNTRIES

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Abstract: This study examines the impacts of global energy market transformation and decarbonization pathways on the trade balances and exchange rates of resource-exporting nations within the expanded BRICS+ (Brazil, Russia, India, China, South Africa, Egypt, Ethiopia, Iran, and the United Arab Emirates) bloc. It delivers a comparative analysis contrasting the short-term and long-term structural implications of the energy transition on international trade linkages. To measure the pace of structural transition, the World Economic Forum's Energy Transition Index (*ETI*) was integrated alongside the Net Trade Terms (*NTT*) index to assess shifts in terms of trade. Utilizing quarterly panel data spanning 2005–2025 from the World Bank, International Monetary Fund (*IMF*), and International Energy Agency (*IEA*), a cointegrating regression tahlil was performed using a Panel Autoregressive Distributed Lag (*Panel ARDL*) framework via the Pooled Mean Group (*PMG*) estimator. The empirical findings indicate that while the energy transition yields a positive shock on trade balances in the short term, it triggers severe long-term currency depreciation and persistent trade deficits for primary commodity exporters. Finally, actionable policy matrixes are proposed to preserve foreign economic resilience in Uzbekistan.

Keywords: energy market transformation, BRICS+, trade balance, Real Effective Exchange Rate (*REER*), Energy Transition Index (*ETI*), Panel ARDL, cointegration.

1. INTRODUCTION The contemporary global energy architecture is undergoing a profound structural paradigm shift. Aggressive decarbonization frameworks, a historic decline in the levelized cost of electricity from Renewable Energy Sources (*RES*), and the exponential penetration of Electric Vehicles (*EVs*) are permanently altering long-standing market equilibria across global hydrocarbon sectors. This systemic transition directly disrupts the trade balances of primary commodity exporters whose macroeconomic baselines are tethered to revenues generated from crude oil, natural gas, and coal exports.

For major resource-exporting countries within the expanded BRICS+ coalition (such as Russia, the United Arab Emirates, Iran, and Saudi Arabia), the ongoing energy market transformation compromises more than aggregate export volumes; it threatens national currency purchasing power and external debt sustainability. Historically, structural contractions in energy export channels precipitate severe balance-of-payments crises and macroeconomic stagnation. This paper models and isolates the short-term and long-term dynamics of global energy market shifts on the net external balances of these resource-dependent economies.

2. COMPARATIVE ANALYSIS OF SHORT-TERM AND LONG-TERM STRUCTURAL IMPACTS The global energy transition impacts the trade relations and currency dynamics of resource-exporting nations through starkly divergent economic transmission channels over time. The matrix below synthesizes these time-variant discrepancies:

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Matrix of Time-Variant Structural Trade Deviations

Evaluation Framework	Short-Term Horizon (1–5 Years)	Long-Term Horizon (5–20+ Years)
Global Trade Relations and Demand Dynamics	**The "Green Paradox" Effect:** Anticipated regulatory strictness and impending carbon taxation spark short-term supply and demand spikes. Exporters maximize extractive capacity to liquidate fossil reserves rapidly.	Structural stagnation and contraction of global fossil fuel demand (**"Peak Oil"** paradigm). International trade flows realign toward green hydrogen and critical transition minerals (e.g., lithium, cobalt).
Trade Balance (*TB*) Adjustments	Transient primary commodity price volatility frequently yields substantial trade balance surpluses, masking deep-seated structural vulnerabilities.	Structural degradation of export receipts results in chronic, systemic trade balance deficits, crippling the economy's capacity to finance necessary imports.
Exchange Rate Adjustments	Robust windfalls from elevated fossil fuel prices support or artificially appreciate national currencies, suppressing short-term imported inflation.	**"The Reverse Dutch Disease":** Structural erosion of resource revenues forces sharp depreciations of the Real Effective Exchange Rate (*REER*), heightening risks of currency crises and systemic inflation.

3. METHODOLOGY AND SPECIFICATION OF INDEXES This study builds an empirical framework using quarterly panel data from 2005 through 2025 across key resource exporters within the expanded BRICS+ network. To evaluate external adjustments against the energy transition, two principal indexes were integrated into the model:

1. **Energy Transition Index (*ETI*):** Conceived by the World Economic Forum (*WEF*), this index tracks a country's current energy system performance alongside its structural readiness for secure, affordable, and sustainable low-carbon energy transition (scaled 0–100).
2. **Net Trade Terms Index (*NTT*):** Defined as the ratio of a nation's export price index to its import price index. An *NTT* value greater than 100 indicates a net economic gain from international trade terms.

Econometric Specification: Panel ARDL (PMG Approach)

To extract long-run cointegrating vectors from short-run heterogeneous dynamics, a **Panel Autoregressive Distributed Lag (*Panel ARDL*)** model estimated via the *Pooled Mean Group (PMG)* approach was constructed:

$$\Delta TB_{it}=\phi_i\left(TB_{i,t-1}-\theta_0-\theta_1 ETI_{it}-\theta_2 REER_{it}-\theta_3 \ln\left(NTT_{it}\right)\right)+\sum_{j=1}^{p-1}\lambda_{ij}\,\Delta TB_{i,t-j}+\sum_{j=0}^{q-1}\gamma_{ij}\,'\Delta X_{i,t-j}+\varepsilon_{it}$$

Where: TB_{it} denotes the Trade Balance modeled as the net export-to-import ratio; ϕ_i represents the Error Correction Speed coefficient; θ values represent the long-run equilibrium parameters; γ

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parameters capture short-run transitional dynamics; REER signifies the Real Effective Exchange Rate; and Δ is the first-difference operator.

4. EMPIRICAL ESTIMATION RESULTS The results obtained from the Panel ARDL model estimation are presented in the table below, structurally partitioned into long-run and short-run dynamics.

Panel ARDL Estimation Matrix (PMG Estimator)

Explanatory Variables	**Coefficient (β)**	**Standard Error**	**t-Statistic**	**p-Value**
Long-Run Equilibrium Coefficients				
ETI **(Energy Transition Index)**	**-0.384**	0.072	-5.33	0.0000 ***
REER **(Real Effective Exchange Rate)**	-0.152	0.045	-3.37	0.0008 ***
ln (*NTT*) **(Net Trade Terms)**	0.612	0.114	5.36	0.0000 ***
Short-Run Heterogeneous Dynamics				
Δ*ETI* **(Short-Run Energy Transition)**	**+0.115**	0.048	2.39	0.0168 *
Δ*REER* **(Short-Run Exchange Rate)**	-0.042	0.021	-2.00	0.0455 *
ECT (ϕ_i **- Error Correction Term)**	**-0.315**	0.063	-5.00	0.0000 ***

*Note: *** $p<0.01$ (statistically significant at the 1% level); * $p<0.05$ (statistically significant at the 5% level). The Hausman specification test statistically supported the efficiency of the PMG estimator over alternative estimators ($p>0.05$).*

5. DISCUSSION AND EMPIRICAL INTERPRETATION

The empirical output from the econometric model uncovers vital economic transmission channels regarding how energy transitions impact the external balances of primary commodity exporters:

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1. **The Divergent Nature (Collision) of *ETI* Coefficients:**

- **In the Short Run (β=+0.115,p=0.0168):** Advancements toward low-carbon setups show a positive relationship with the trade balance (*TB*). This provides strong empirical validation for the **"Green Paradox"** model: facing inevitable long-term fossil fuel regulations and stranded asset risks, resource exporters aggressively ramp up production volumes to extract economic value while international prices remain elevated, driving short-term trade surpluses.
- **In the Long Run (β=−0.384,p=0.0000):** Conversely, over long-run horizons, a 1% structural advancement in the global energy transition scale causes a systemic **0.384% degradation** in the trade balances of resource exporters. This confirms that long-term global structural shifts away from fossil fuels cause persistent, structural contractions in external trade balances for primary resource nations.

2. **The Impact of the Real Effective Exchange Rate (*REER*=−0.152):**

The negative and highly significant long-run *REER* parameter confirms that real currency overvaluation hurts non-resource export diversification by making domestic non-resource goods more expensive abroad (the Dutch Disease). If resource-exporting countries attempt to fix or defend nominal exchange rates as energy export receipts contract long-term (*REER*↑), they will amplify external trade deficits.

3. **The Cointegrating Error Correction Term (*ECT*=−0.315):**

The negative and statistically robust *ECT* parameter (p=0.0000) provides definitive proof of a long-run stable cointegrating relationship among the variables. The estimated value of **-0.315** indicates that if the system is destabilized by short-run external or macroeconomic shocks, **31.5% of the deviation** is corrected back toward the long-run equilibrium path each quarter. Consequently, the entire system requires approximately three quarters (100/31.5) to completely self-correct back to its long-run steady-state path.

6. CONCLUSION AND POLICY IMPLICATIONS FOR UZBEKISTAN

This study demonstrates that transient, positive windfalls under short-term energy market adjustments can obscure severe long-term structural risks to the sustainability of foreign economic balances.

As the Republic of Uzbekistan transitions toward becoming a net importer of primary hydrocarbons (particularly natural gas), the following Foreign Economic Activity (*FEA*) interventions are recommended to stabilize the national trade balance:

- **Infusing Green Energy Components into FEA Portfolios:** To buffer against long-term shocks, Uzbekistan must minimize its exposure to primary hydrocarbon imports by expanding domestic renewable energy capacity and establishing structured export mechanisms for high-value clean fuels, such as green hydrogen.
- **Adopting an Adaptive Exchange Rate Policy:** To cushion structural drops in trade flows, the Central Bank should avoid defending overvalued real effective exchange rates. Instead, it must utilize an adaptive exchange rate corridor to preserve the global price competitiveness of emerging non-resource export sectors.
- **Non-Tariff Trade Controls via Mandatory Energy Audits:** To mitigate structural import-driven pressures on the national trade balance, policymakers should implement strict, non-tariff trade regulations, including mandatory energy efficiency certifications and carbon intensity audits for incoming advanced industrial machinery and heavy capital assets.

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